19th AIRCRAFT AND MISSILE PRODUCTION NUMBER · JULY, 1959

Machinery

For Hot Forming and Straightening

CLEARING'S AIRCRAFT & MISSILE DIVISION

CLEARING'S AIRCRAFT AND MISSILE DIVISION CAN HELP YOU

By Designing & Building
Machinery For...
Roto Forging—Stretch Forming
Honey Combing

AND IF YOU NEED EQUIPMENT
FOR GROUND SUPPORT AND
GROUND HANDLING, CALL ON US.

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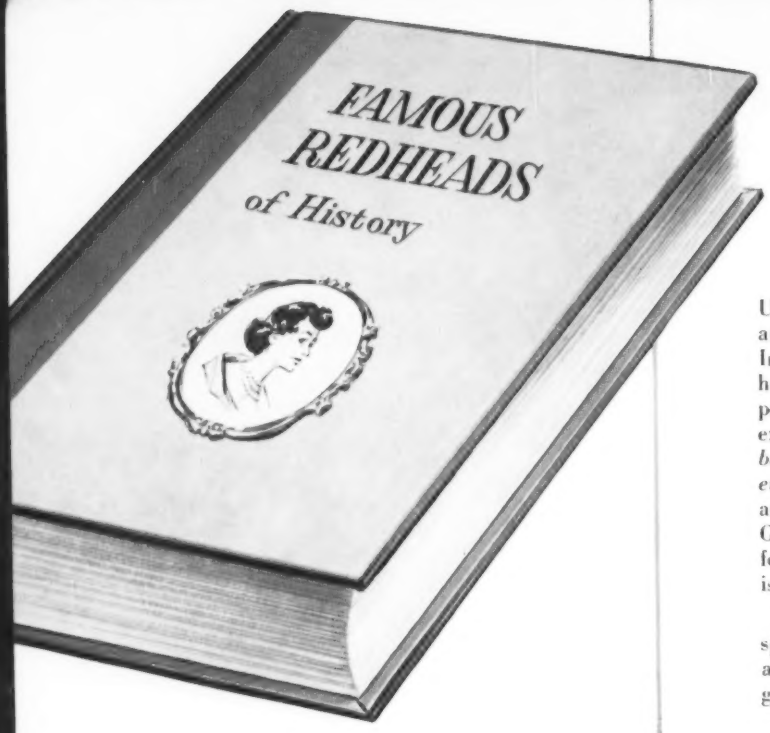


in the past...

Throughout the ages, redheads have acquired a reputation for being glamorous, adventurous, unpredictable and often temperamental—greatly admired or greatly envied. Cleopatra, Queen Elizabeth, Madame Pompadour, Mary Queen of Scots, Lady Hamilton, Nell Gwynn, Madame Dubarry, Sarah Bernhardt—some of history's most tempestuous titian-haired beauties undoubtedly contributed to this fame.

In literature, too, redheads have often been cast in similar roles—like Nana, Sadie Thompson, Becky Sharpe and Scarlett O'Hara, to mention just a few.

The relationship between hair coloring and personality may have been sheer coincidence. But the fact remains that redheads usually stand out from the crowd in more than appearance alone.

RED HEAD
HEALD

in the present...

Unlike their feminine counterparts, Heald Red Heads are *not* temperamental and definitely *not* unpredictable. In fact Heald Red Head boringheads and wheelheads have achieved an enviable reputation for dependable performance, based on more than 30 years of operating experience. And today, the Red Head line includes *six basic types*, in sizes, speeds and capacities for virtually *every* metal-working application. Heald Red Heads are available not only for Heald Bore-Matics and Internal Grinders, but also (and many people do not realize this) for use with any similar types or makes of precision finishing machines.

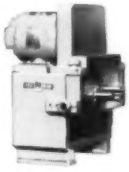
From this complete Red Head line you can select a spindle unit that will help you improve product quality and cut production costs on any boring or internal grinding job.

RED HEAD BELT-DRIVEN WHEELHEADS
Cool-running, permanently lubricated wheelheads for standard belt drive. Sleeve Style, Naked Style and Quill Style heads for speeds up to 40,000 rpm.

RED HEAD HI-FREQUENCY WHEELHEADS
Permanently lubricated or mist lubricated precision wheelheads for Hi-Frequency drive. Naked Style, Quill Style or for mounted point wheels. Speeds up to 100,000 rpm.

RED HEAD HI-SPEED BELT DRIVEN WHEELHEADS
New head design permits small hole grinding at speeds from 45,000 to 100,000 rpm without the need for high frequency generating equipment.

RED HEAD BORINGHEADS
Permanently-lubricated belt-driven boringheads for high-precision Borizing with rotating tools or rotating work. Speeds to 8,000 rpm.; available in a wide range of sizes.



RED HEAD MULTI-SPINDLE BORINGHEADS
Permit simultaneous multiple-hole Borizing with centers as close as ¾". Miniature Precision Red Heads, with common belt drive, mounted in interchangeable precision-bored spindle plates.

RED HEAD BORIZERS
Completely self-contained motor driven, hydraulically powered head units for rotating, feeding and retracting single or multiple tools in automated setups.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

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Machinery

JULY 1959 **VOL. 65 No. 11**

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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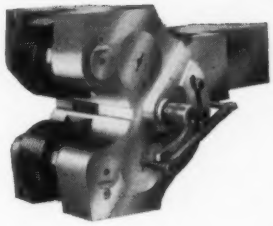
3
LANDIS HAS ALL THREE

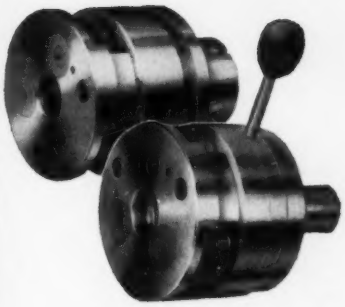
THREAD ROLLING MACHINES

. . . produce strong, accurate threads of excellent finish by the chipless, cold-forming process . . . produce left- and right-hand threads of all types (except square), including UNC, UNF, Acme, worm, and many special forms.



THREAD ROLLING ATTACHMENTS

. . . produce either straight or tapered threads . . . exclusive features include: tipping to avoid indexing interference . . . simple design allows disengaging attachment without disturbing set-up . . . and a gage determines precise position where vertical centerlines of both rolls and workpiece coincide.



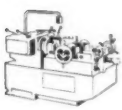
THREAD ROLLING HEADS

. . . produce Class 4 threads of excellent finish at high speeds . . . feature replaceable helix angle bushings which allows rolling threads with exact helix angles without purchasing major head components.

Whatever your Thread Rolling requirement, there is a LANDIS machine or tool to do the job. Our detailed knowledge of the most efficient application of the different methods of thread rolling—and our more than 50 years experience in the threading field—has resulted in our producing a complete line of thread rolling equipment. Make LANDIS your one-stop source for all your thread rolling needs. When inquiring about Thread Rolling, describe your operation and send specifications.

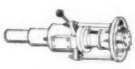
LANDIS *Machine* COMPANY / WAYNESBORO PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

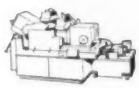


Threading Machines

Die Heads—Rotary & Stationary



Taps—Collapsible & Solid Adjustable



Centerless Thread Grinding Machines

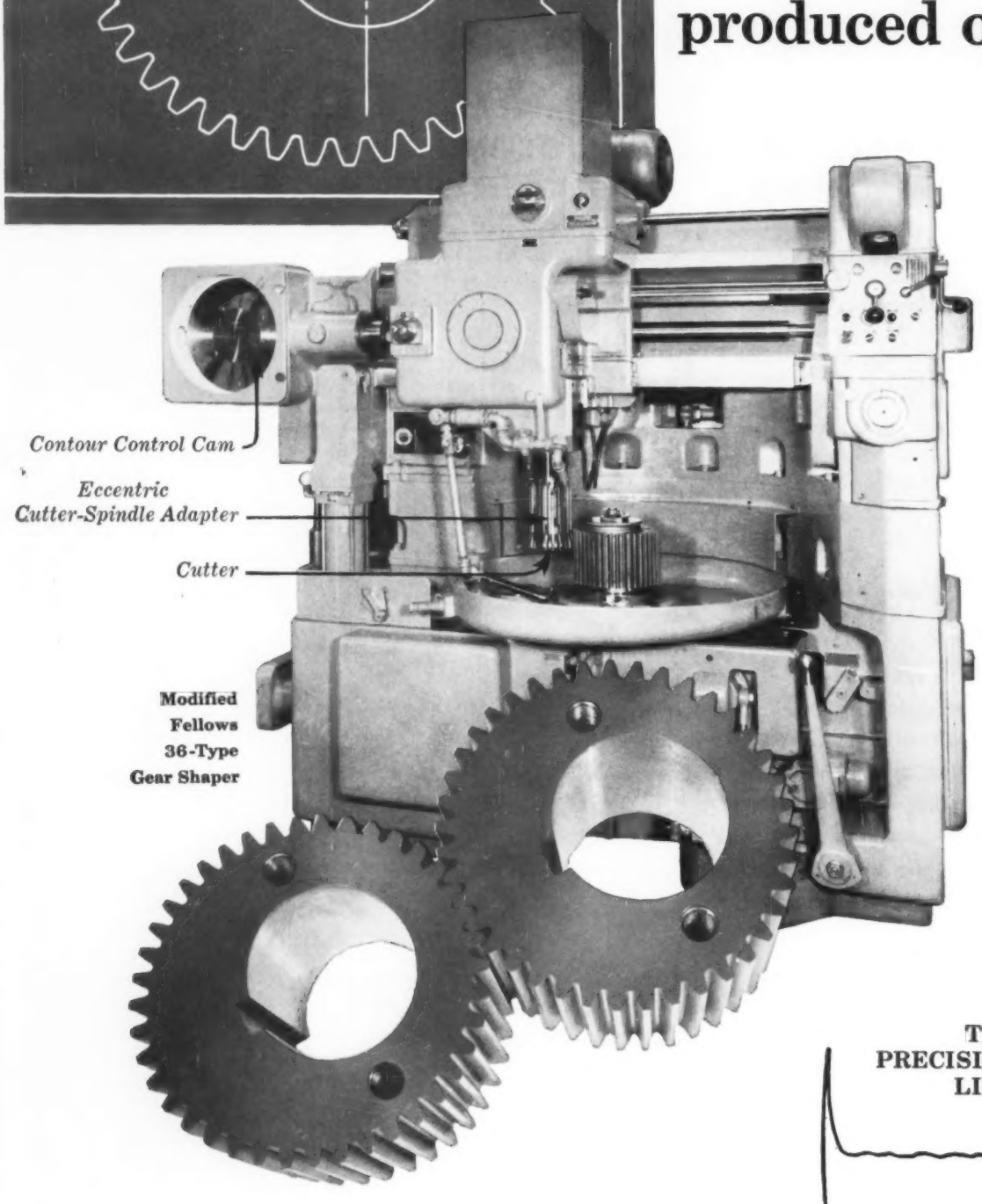
Thread Rolling Tools

Thread Rolling Machines

550C

ELLIPTICAL AND

produced on



THE
PRECISION
LINE

OVAL GEARS

Fellows 36-Type Gear Shaper

Now...you can generate accurate oval and elliptical gears, and other irregular shapes, rapidly and economically. Once setup is made, production is as simple as in cutting conventional cylindrical gears. This new method minimizes the difficulty of wide variations in backlash experienced with such gears cut by previous methods. Full or modified involute teeth are produced to a higher degree of accuracy than was ever possible before on gears of this type.

Oval and elliptical gears are produced by continuously varying the center distance between cutter and gear during the cutting operation. A contour cam and a follower move the saddle the required amount in timed relationship with the rotation of the eccentric cutter-spindle adapter. The required pitch line contour of the gear is determined by the control cam and the eccentric adapter.

Although the Modified 36-Type Gear Shaper can be used to produce conventional external gears up to 18″ pitch diameter by substituting a cylindrical cam and concentric cutter adapter, it is primarily a special purpose machine for oval and elliptical gears. Special stroke parts are required for cutting face widths from 6″ to 10″. For full information, get in touch with any Fellows office.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
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Fellows *Gear Production Equipment*

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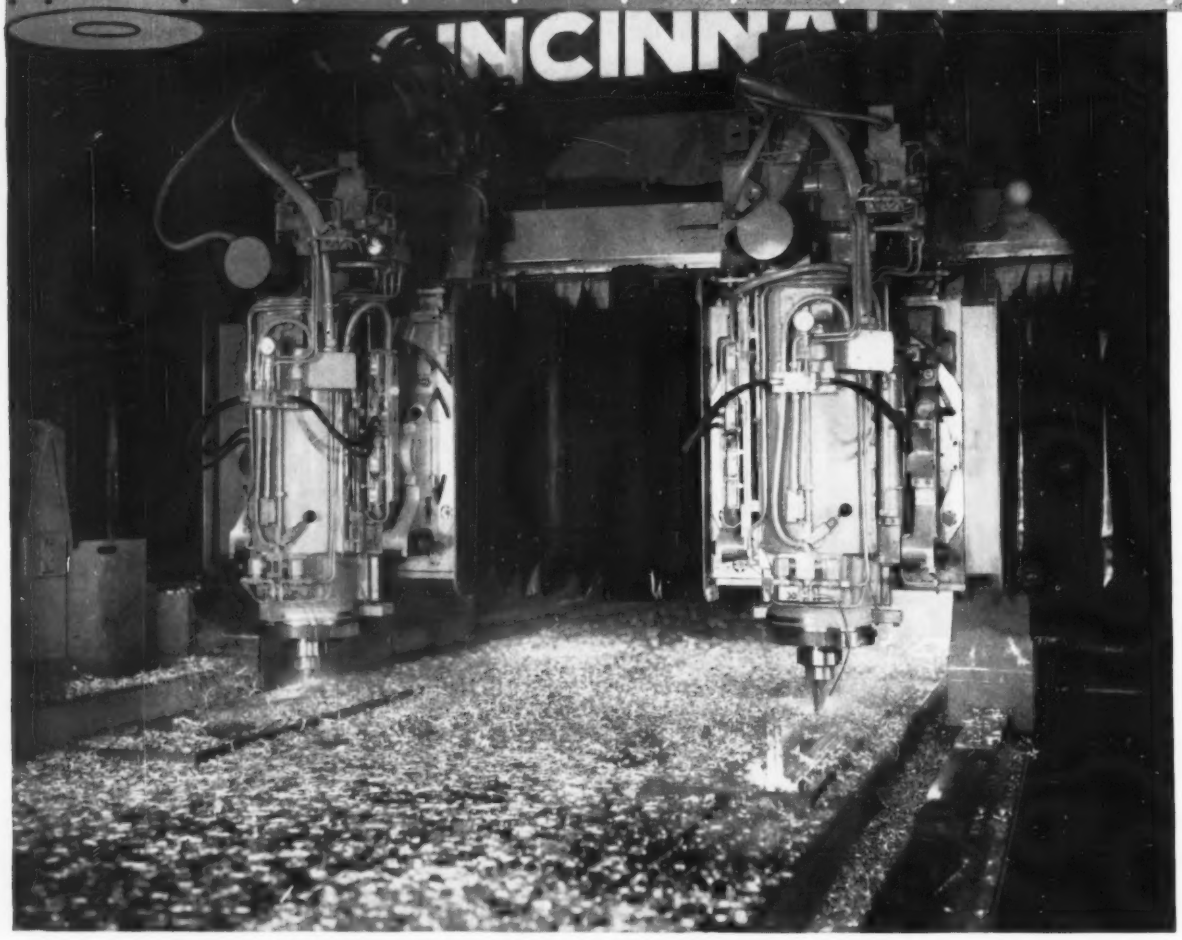
CNC SKIN MILLER

Automatically Mills



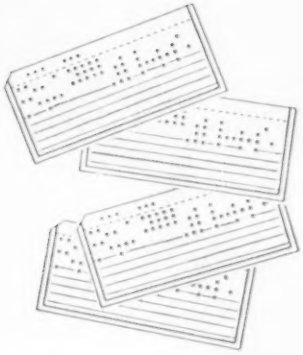
Chips quickly obscure the right- and left-hand parts being milled simultaneously on this CNC Skin Miller. Two independently powered milling heads are driven by 50/100 hp motors.

Contours and recess of this 5 ft. aluminum part are automatically milled on CNC Machines. Many complex parts of this type are produced in 1/5 the time required by conventional methods.

BUILDERS OF FINE MACHINE TOOLS: MILLING • GRINDING • BROACHING • DIE SINKING • CUTTER AND TOOL GRINDING

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

Right- and Left-hand Parts Simultaneously



80% reduction in machining time is not at all unusual for CINCINNATI Numerically Controlled (CNC) Skin Millers. Compared to conventional tracer controlled methods, savings in both machining time and costs always are substantial. In addition, new and reground cutters can be used with the same CNC program because the system automatically compensates for variations in cutter diameter. Other Cincinnati advantages include: *Single Responsibility,* a coordinated, cooperative effort by Cincinnati specialists in numerical control and in every activity required to deliver completely integrated machines. *Simple Programming* . . . CNC requires fewer input data points. *Precision Machining* . . . CNC is an absolute digital-analog system, assuring precise accuracy of control. *Simple to Use, Versatile;* card or tape control elements.

Cincinnati Numerical Control gives you positive cost control at the machine. Want specific job application data? Just present your production problems to us. You may obtain preliminary information by writing for publication M-2066.

CNC SKIN MILLING MACHINE. *Working surface of the table is 12 ft. x 45 ft., and extra lengths can be added if desired. The machine incorporates three types of control: finger-tip hand control . . . conventional power control . . . three-axis numerical control.*

• PRODUCTION LINES • METAL FORMING, HARDENING MACHINES

CINCINNATI®

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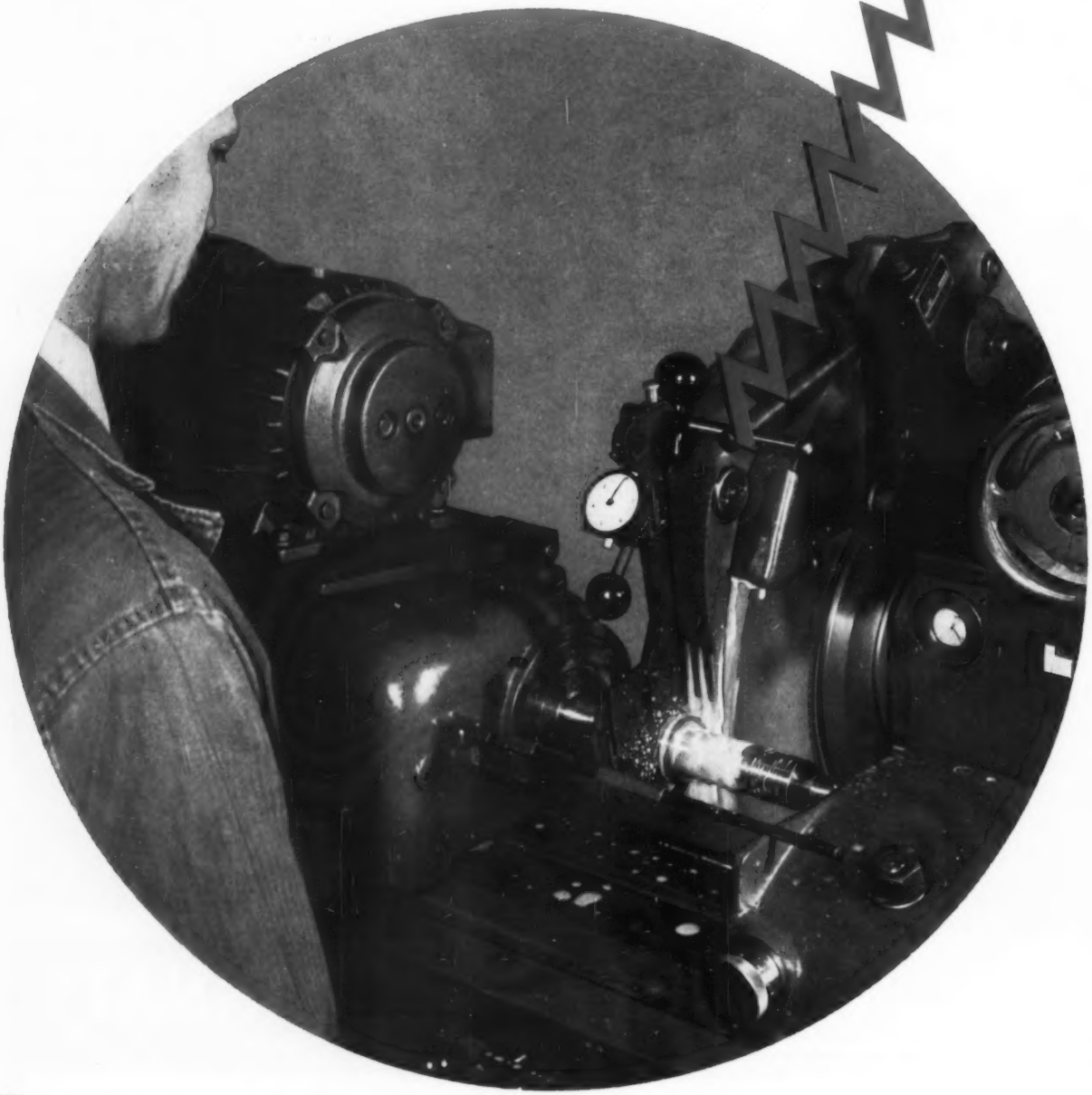
LANDIS micro



feed

for grinding to your closest tolerances...automatically

MICROFEED, a new precision wheel feed, is the biggest news in cylindrical grinding today. MICROFEED, on a new Landis grinder, assures precision to extremely close tolerances on a production basis.

This radically new wheel feed automatically cancels all variables which affect precision grinder feed systems. On piece after piece MICROFEED repeats its action with unerring accuracy.

LANDIS

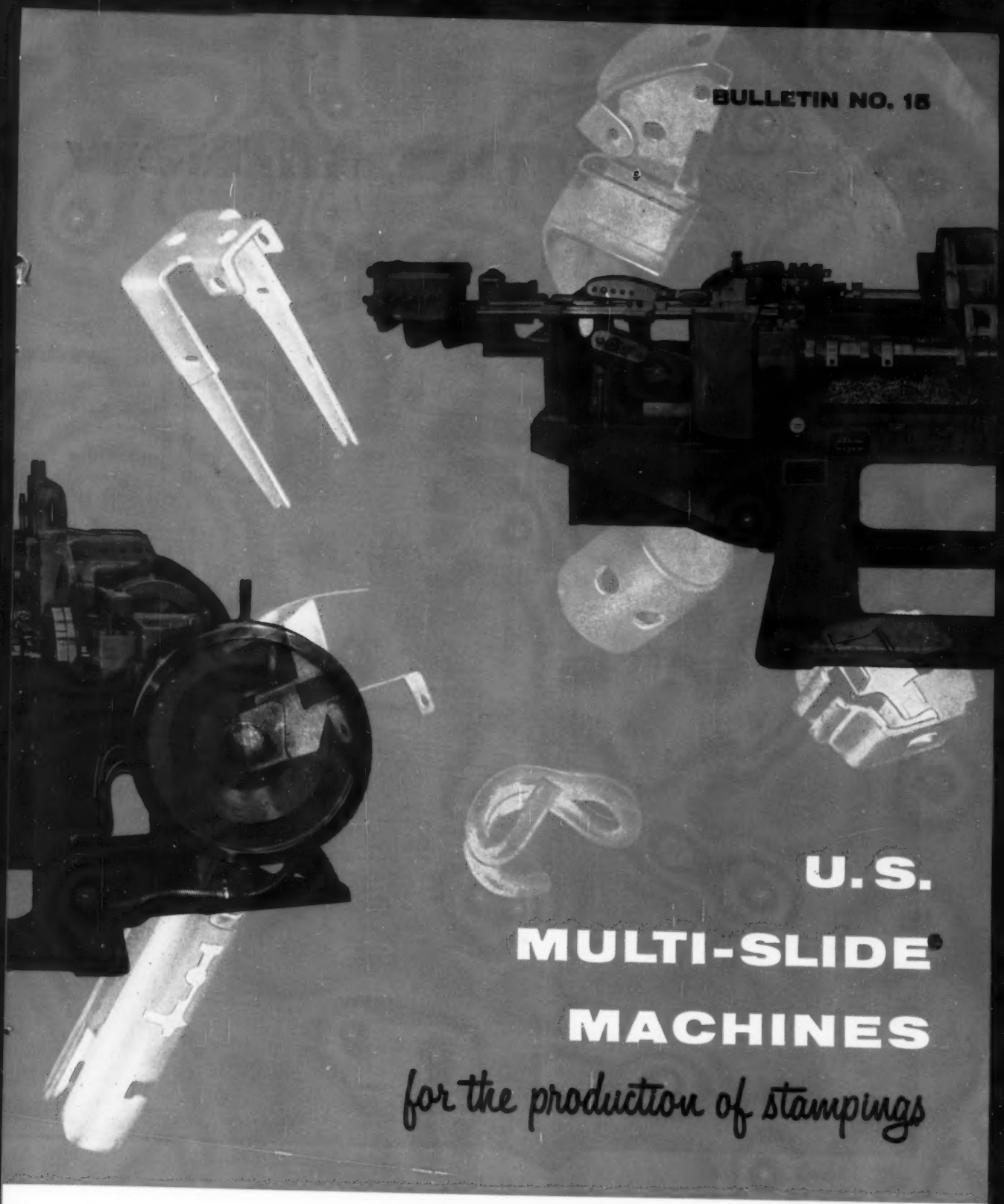
precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

FOR PROFITABLE PRODUCTION OF STAMPINGS

There are U. S. Multi-Slide® Machines that will produce many different types of formed metal stampings ... faster, better and less expensively than you have ever been able to produce them before. Write for your free, 16 page U. S. BULLETIN No. 15M which will tell you how and why.

BULLETIN NO. 15



U.S. MULTI-SLIDE® MACHINES

for the production of stampings

PRODUCTS

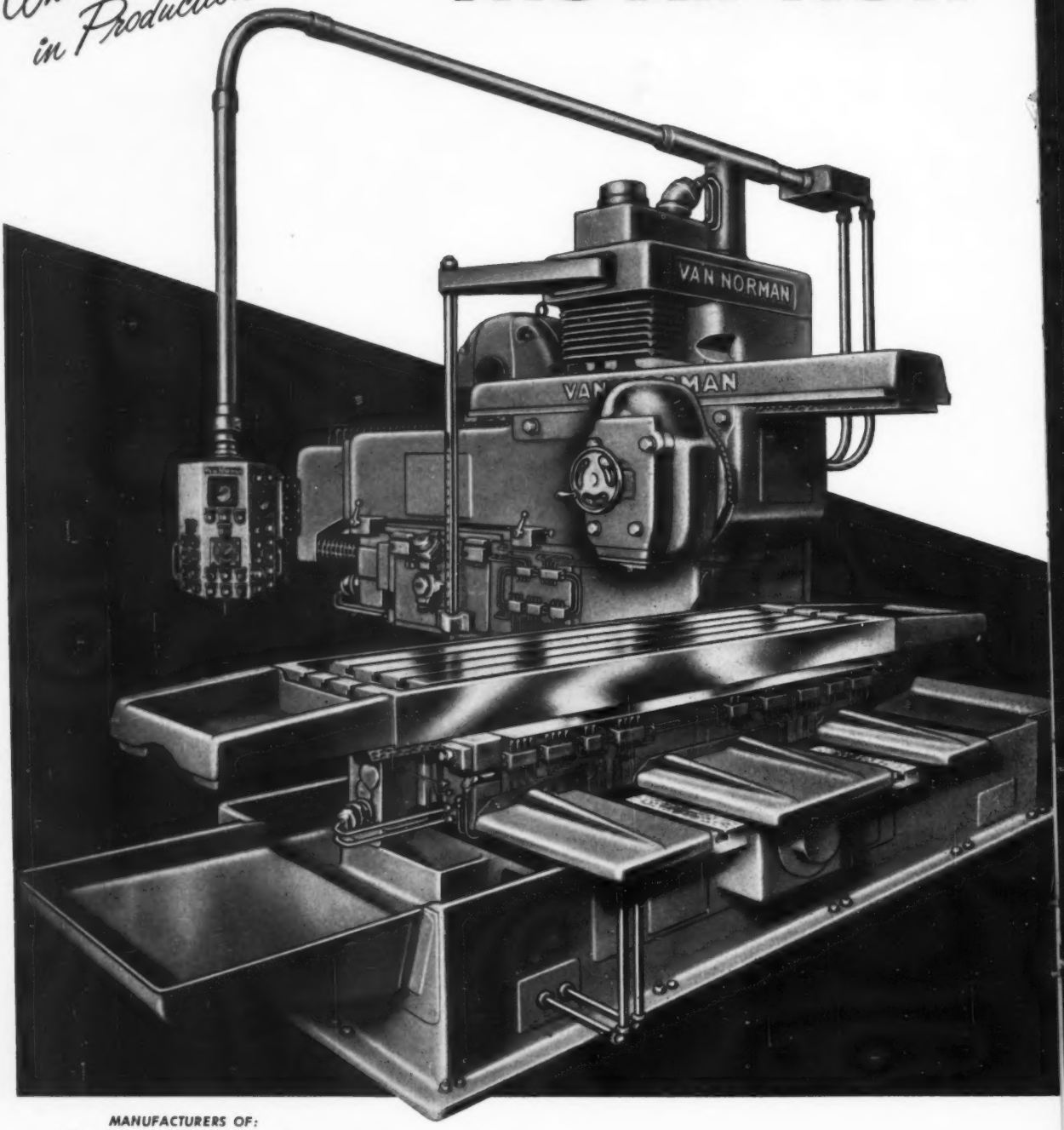
U. S. TOOL COMPANY, INC.

AMPERE *(EAST ORANGE)* NEW JERSEY

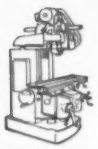
U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

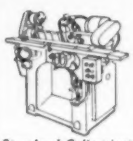
What's New, Newest in Production Millers?

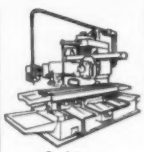
The All-New

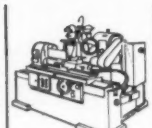


MANUFACTURERS OF:


Milling Machines


Standard Cylindrical Grinders


Bed-type Mills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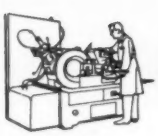
Centerless Grinders

VAN NORMAN

SPRINGFIELD 7, MASSACHUSETTS

Van Norman 746
VERSI-MATIC

- **Designed and built for modern production**
- **Engineered for numerical control**
- **Offers maximum rigidity — accuracy — versatility — range — horsepower**
- **An 18-ton precision-built bed-type miller**
- **Also available without saddle**

Here it is — the newest thing in production millers — just the machine to cut or shape all of the new, tough super alloys while still maintaining exacting tolerances. *And* the 746 retains all the famous Van Norman quality features including the exclusive Van Norman 4-way cutterhead.

Examine closely the detailed specs of this newest Van Norman production miller. Then contact your nearest Van Norman dealer or write directly to Springfield.

We'll be glad to show you how the 746 Versi-Matic can fit into *your* production line.

SPECIFICATIONS

NO. 746 VERSI-MATIC VAN NORMAN SADDLE BED TYPE MILLING MACHINE
NO. 796 VAN NORMAN BED TYPE MILLING MACHINES

		746 with Saddle	A.I.A.* Med. Size	796 without Saddle
TABLE SIZE	Length	96"	94"	108" also 130"
	Width	24"	20"	30"
	T-Slots (3)	1 3/16"	1 3/16"	1 3/16"
POWER FEED TRAVEL	Longitudinal	50"	50"	72" also 108"
	Transverse (Saddle)	14"	14"	—
	Transverse (Ram)	44"	—	44"
	Vertical	35"	20"	48"
CLEARANCE MAX.	Spindle to Table (Horiz.)	35"	20"	48"
	Spindle to Table (Vert.)	22"	—	35"
	Cutter Dia.	16"	16"	16"
POWER FEEDS IPM	Longitudinal (Table)	1/3-90	1/3-90	1/3-90
	Transverse (Saddle)	1/3-90	1/3-90	1/3-90
	Transverse (Ram)	3/16-45	—	3/16-45
	Vertical	3/16-45	3/16-45	3/16-45
	No. Steps	Inf.	32	Inf.
	Rapid Traverse (Table & Saddle)	150	150	150 (table only)
	Rapid Traverse (Vert. & Ram)	75	—	75
SPINDLE	Horsepower	25 50	25 50	25 50
	R.P.M.	15-1500	15-1500	15-1500
	No. Steps	18	16	18
	Head Swivels	120° (30° by vert.)	—	120° (30° by vert.)
	Taper	ASA 50	ASA 50	ASA 50
	Flange	ASA 60	ASA 60	ASA 60
WEIGHT	Net approximately	37,000 lbs.	—	41,000 lbs.

*Aircraft Industries Association NAS-909 Specifications.

MACHINE COMPANY
A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED

Don't wait . . . for extra profit install a Van Norman machine now! They are available in many purchase plans . . . Outright sale . . . Purchase on conditional sales contract up to five years . . . Pay as you depreciate up to 10 years. Conditional Sales Contracts not available to Export.

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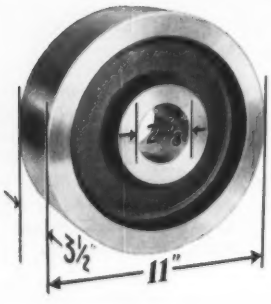

SIX OPERATIONS WERE REDUCED TO THREE when this chrome molybdenum spur gear was blanked out on the Warner & Swasey 3AC s. Premium-grade carbide cutters are used throughout, many with throw-away tips to minimize downtime for cutter changing.

Fairfield's old method on this part required drilling, round broaching, spline broaching and three turning operations. Now all operations except spline broaching are combined into two chuckings – one on each of two 3AC machines – handled simultaneously by one operator. The result – blanking costs dropped 42%. After spline broaching the blanks are ready for machining of gear teeth. Lot sizes average about 200 pieces with frequent runs of only 25 pieces.

At Fairfield Manufacturing Company

Lafayette, Indiana

GEAR BLANKING COSTS CUT IN HALF –even on Job Lots– with WARNER & SWASEY SINGLE SPINDLE CHUCKING AUTOMATICS

Fairfield, one of America's largest independent producers of precision cut, automotive-type gears, had a production "bottleneck" in their gear-blanking department.

To increase production and still keep costs in line, particularly on the smaller lots, greater machine tool versatility was needed. Method analyses revealed that any new production equipment under consideration should be more rigid for greater accuracy—capable of using the latest in carbides for faster metal removal—and permit combining of extra operations into single chuckings through more efficient tool setups and thus eliminate costly special tooling.

New Warner & Swasey ACs fulfilled these conditions. Ten machines – six 2 ACs and four 3 ACs—were installed over a period of four years. From the start of the first pair of machines, production increased immediately, costs dropped substantially!

Fairfield's new Warner & Swasey Single Spindle Automatics provided:

- **Extreme boring and turning accuracy that completely eliminated "green" grinding operations.**
- **Power, speed and rigidity which allowed utilization of today's most advanced cutting tool materials to their fullest capabilities.**
- **Unexcelled reliability which has all but eliminated downtime for other-than-normal preventive maintenance – and this based on around-the-clock operation!**
- **Ample tool stations (five turret and two cross slide positions) coupled with standard tooling ease and flexibility which permitted consolidation of separate operations in a single setup.**

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

WARNER & SWASEY *Cleveland* PRECISION MACHINERY SINCE 1880

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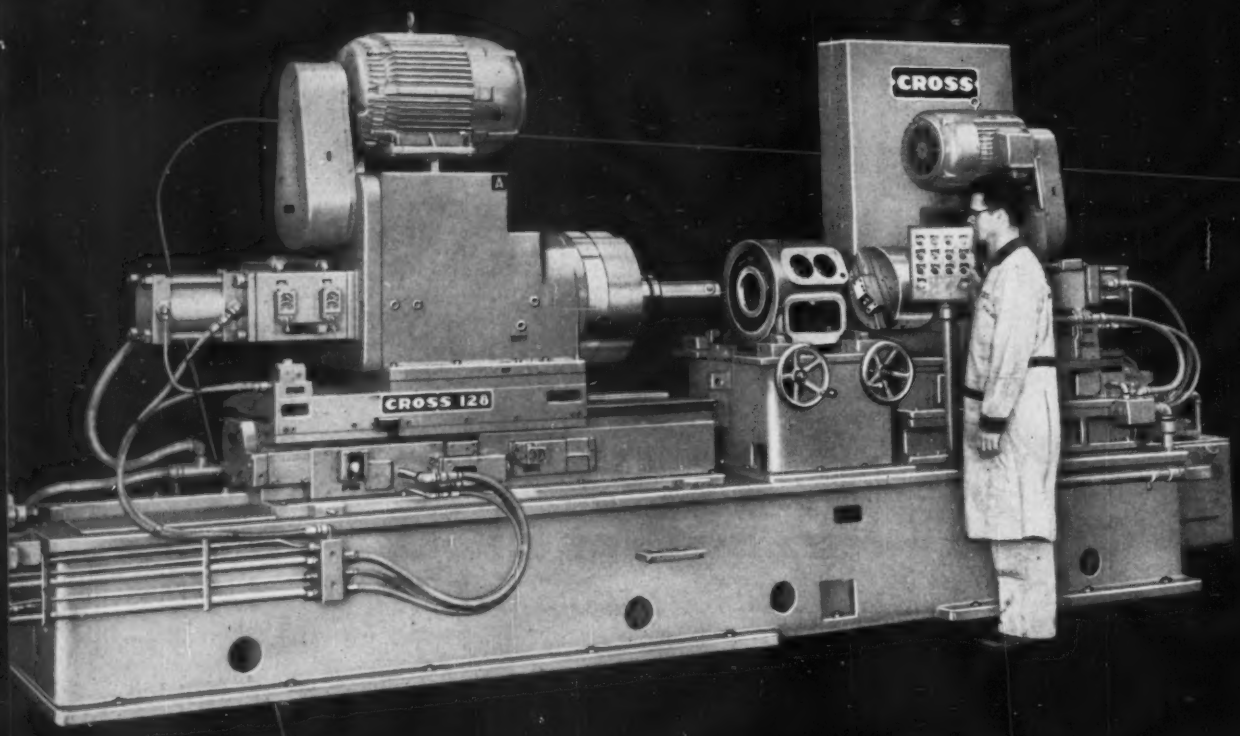
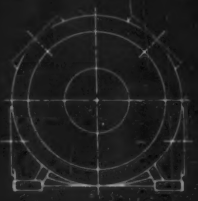
Automation for Short Run, Low Volume Production

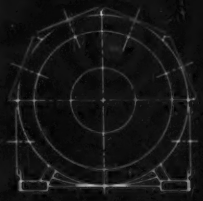


PRODUCT MIX



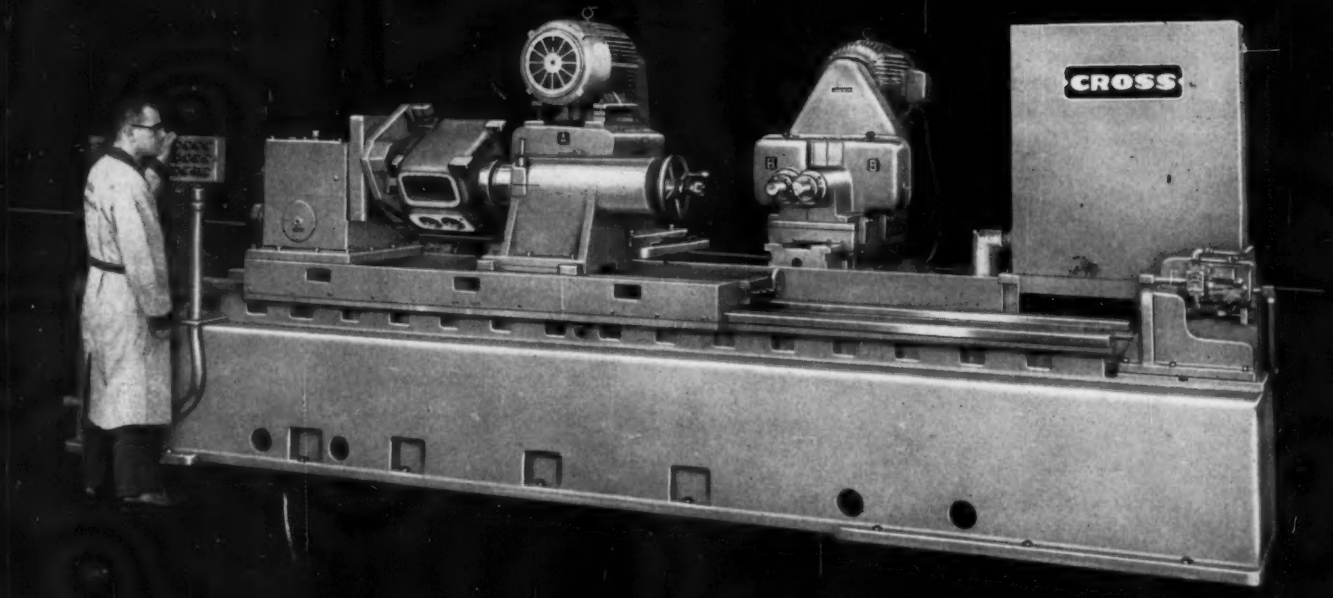
Two-bank compressor for several 4 cylinder models.

Three-bank compressor for several 6 cylinder models.



Four-bank compressor for 8 and 12 cylinder models.

More Specials by Cross



Featuring a high degree of precision, processing versatility and machine flexibility, these two new Cross machines process a complete product mix of 4, 6, 8 and 12-cylinder hermetic compressor housings in lots of 50 each. The two-way boring and facing machine rough and precision finishes crankshaft bores, thrust faces and the motor mounting face. The two-station shuttle-type machine rough and finishes all bank faces and cylinder bores.

Both machines provide completely automatic operations including part indexing and shuttle; incorporate automatic lubrication including new methods of lubricating cross facing heads automatically; and both provide optimum flexibility for handling future part design changes including major dimensional variations in the number, diameter and location of cylinder bores.

Both the two-way and shuttle machine combine rugged dependability for heavy stock removal in roughing with a high degree of accuracy for precision finishing. Critical tolerances are held closely; bank and thrust faces relative to cylinder bores are held square within. 001"; main bore and cylinder bore diameters concentric within .001"; motor mounting face and crank bore thrust faces held parallel within .001".

The two-way and shuttle machines are smaller and far less costly than a group of standard machines that would be required to perform identical operations without automated features and advantages.

Both machines incorporate standard Cross "Building Blocks" including wing bases and feed units. All standard and special parts are completely interchangeable for easy servicing.

For details on these—and other automated Cross machines for profitable, low volume production, write, wire or phone:

Established 1898

THE **CROSS** CO.

First in Automation

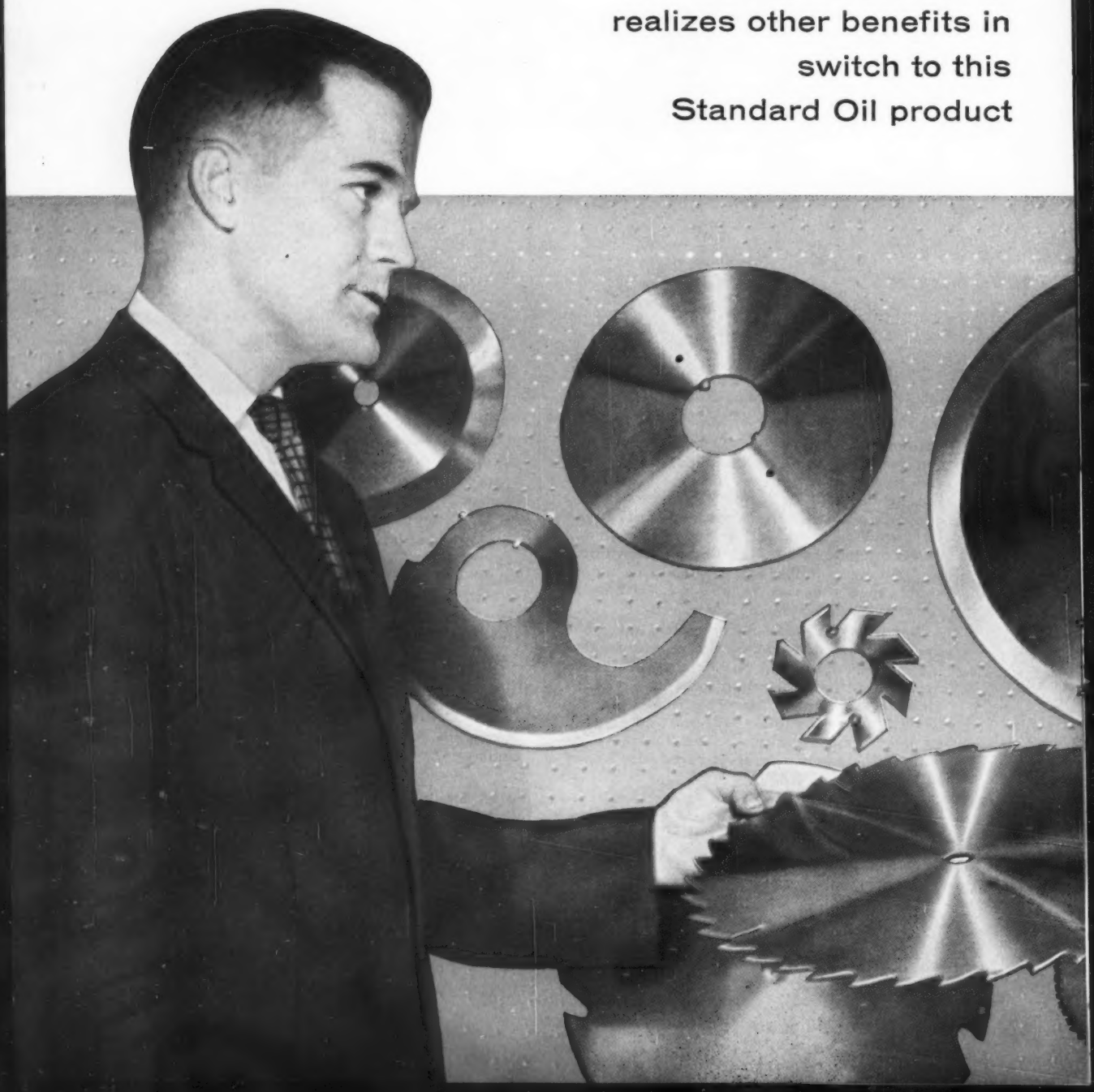
PARK GROVE STATION • DETROIT 5, MICHIGAN

Gets 40% savings in coolant costs by change to

Standard's Transparent Coolant

ARGON Oil No. 4

Chicago Saws, Inc., realizes other benefits in switch to this Standard Oil product

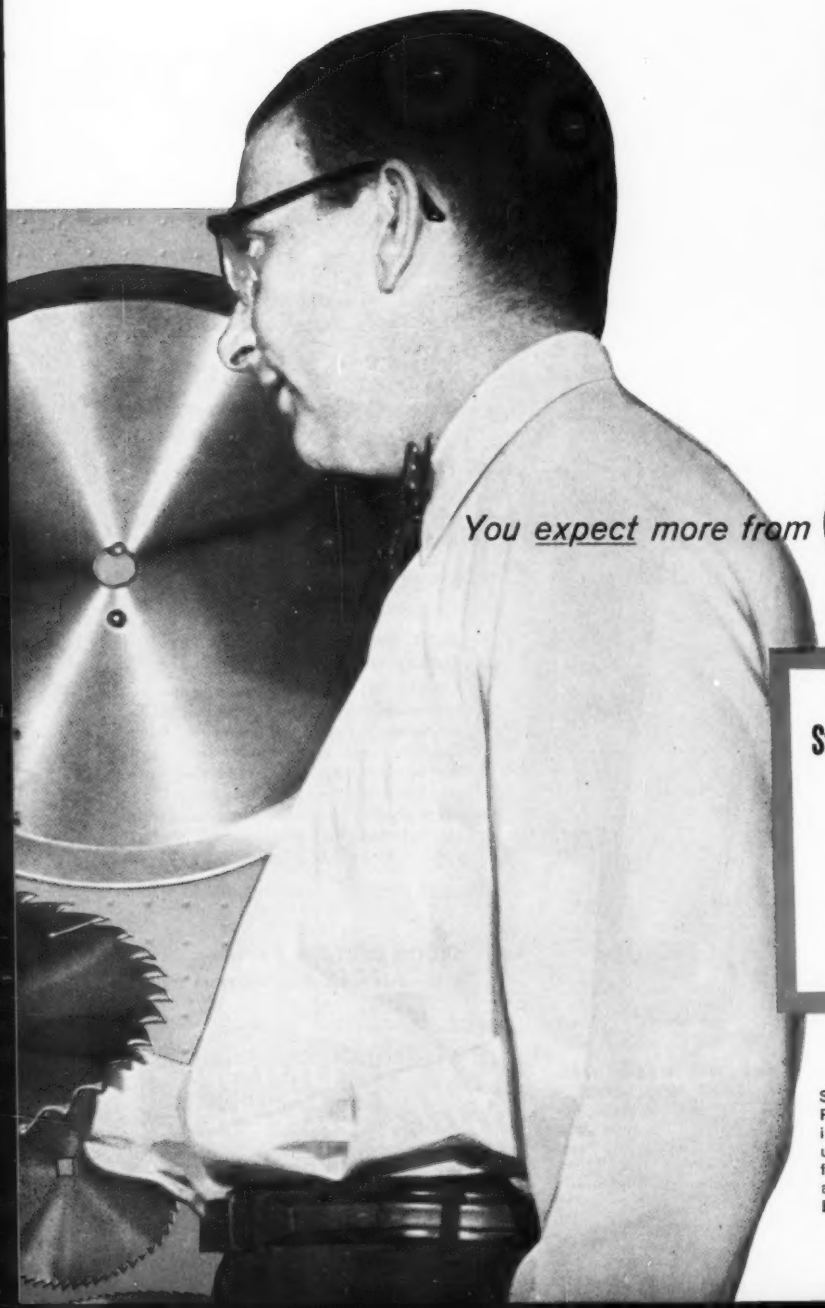


Situation: It all started when a Standard Oil lubrication specialist recommended ARGON Oil No. 4, Standard's transparent coolant to Chicago Saws for use in their grinding operations. This manufacturer of rotary saw blades decided to give it a try. They knew the product was the result of more than three years' work in Standard's research laboratory, and that it had been extensively field tested.

What happened: Using ARGON Oil No. 4 in 100:1 concentration, Chicago Saws was able to reduce coolant costs 40%. They also found the work could be seen more clearly when using this coolant. There was less wheel loading. They also discovered the coolant didn't foam and that its exceptional ability to carry off heat resulted in cooler operation. Faster cuts were obtained with finer wheels. Tolerances were easier to hold. Better finishes were obtained. Wheel dressings were less frequent.

What you can do: Get more information about ARGON Oil No. 4 transparent coolant. Call the Standard Oil lubrication specialist near you in any of the 15 Midwest or Rocky Mountain states. Or write: **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill.**

Using ARGON Oil No. 4, Chicago Saws gets better finish at savings of 40% over other coolants tried. Operator is using .004" cut on heat treated Rockwell 60 C steel.



You expect more from **STANDARD** *and you get it!*

Quick facts about

Standard's Transparent Coolant

ARGON Oil No. 4

- Clear, transparent fluid
- All chemical. Does not support bacteria growth
- Unaffected by humidity
- Nonfoaming
- Fire resistant
- Odorless

Standard's Bob Stark and Chicago Saws' vice president Paul Bostrom discuss blades and coolants. Bob Stark is well qualified to work with manufacturers on the use of metalworking coolants. Bob has a chemistry degree from Illinois College plus three years' experience at Standard. He has completed the Standard Oil Sales Engineering School course.

Here's a NEW WELDING TORCH that's WATERTIGHT... built for HEAVY-DUTY SERVICE ...yet weighs only 7 OUNCES!

This new HELIARC HW-18 Hand Welding Torch weighs only 7 ounces, making it easy for you to handle, less tiring. The special one-piece water cooling channel eliminates sources of leakage. And it's made for rugged, heavy-duty service.

YOU GET BETTER SHIELDING WITH LESS GAS

Improved design of collet body and closer electrode fit assure uniform argon flow, without jetting or turbulence.

GIVES YOU RUGGED SERVICE

Torch body is Fiberglas-reinforced phenolic for greater resistance to heat and thermal shock. Handle is tough, polished plastic. Gas cups have 4 times the impact strength of ordinary cups.

LEAKPROOF

Molded, one-piece water cooling passage has no joints to permit leakage—no water drip to contaminate welds.

◀ Diagram shows leakproof, one-piece water cooling passage in LINDE's new HELIARC HW-18 Hand Welding Torch.

EASY, MORE ECONOMICAL MAINTENANCE

Collets, collet bodies, cups and caps are interchangeable with those of your HW-17 Series 2 Torch. All couplings have standard IAA connections, and adaptors are included. Your production costs are lowered, too, for the new HW-18 saves time in hard-to-reach spots. Torch is designed for continuous 300-amp service, a-c or d-c.

ARGON SHUT-OFF VALVE

(Optional) saves time, steps and argon.

See and try this new HELIARC HW-18 Torch! For a demonstration, mail coupon today. Or call your distributor or nearest LINDE office. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Dept. MY-7 LINDE COMPANY, Division of UCC
30 East 42nd Street, New York 17, N. Y.

Please advise me where and when I can examine and try out the new HELIARC HW-18 Hand Welding Torch.

NAME_____

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____

FOR THE BEST IN ELECTRIC WELDING LOOK TO Linde TRADE-MARK

UNION CARBIDE

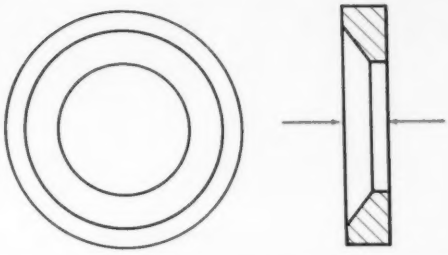
The terms "Linde," "Heliarc," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Disc life up 71% with new Gardner GR structure control

...new Gardner abrasives grind 43,567 *more* valve inserts than former discs

production facts

Part	Valve inserts
Material	Carbon steel
Hardness	35 to 60 Rockwell
Machine	Double Disc Grinder
Disc size	26" x 2" x 10"
Production life	Former discs—61,000 parts New Gardner discs—104,567 parts



Find out how Gardner's latest developments in abrasive discs can lower your grinding costs! Call your Gardner Abrasives Specialist or write for AC-57 Catalog.

GARDNER

abrasive discs

BELOIT, WISCONSIN

the latest word in low cost machining

televersal

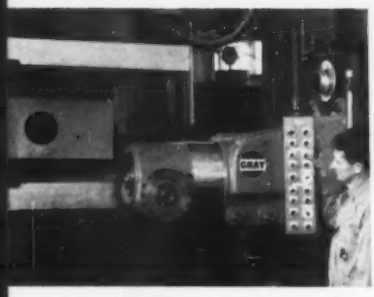
This new GRAY TELEVERSAL head tremendously increases machining range. Conveniently applied, quickly positioned, its great rigidity permits highest horsepower milling cuts.

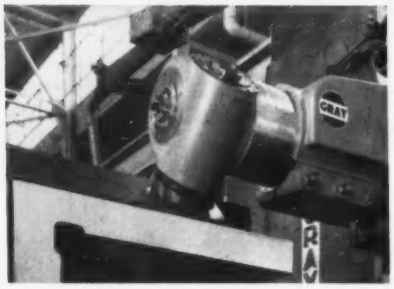
The large diameter quill may be swiveled to permit any angular cut. A triple-straddle clamp inflexibly locks the quill to the cast pyramid body.

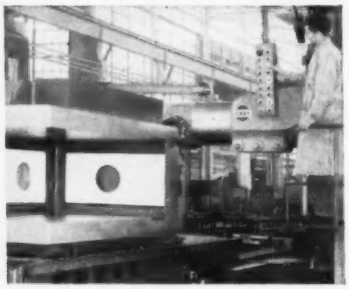
Designed to keep the job low and yet permit great machining range. Ideal when used with column cross travel of the new GRAY horizontal, boring, drilling and milling machine.

Not just an attachment, but a high power massively built, heavy milling unit that offers a new concept in versatility.

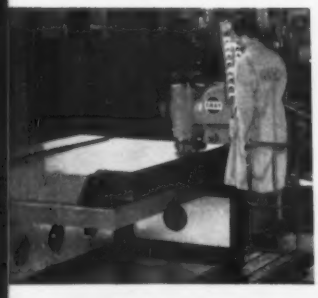
The G. A. GRAY Co., Cincinnati, Ohio

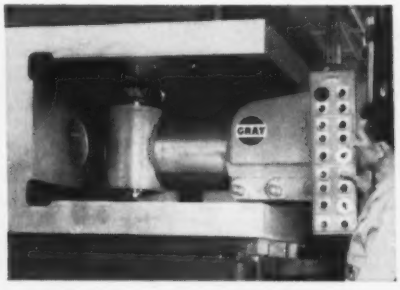


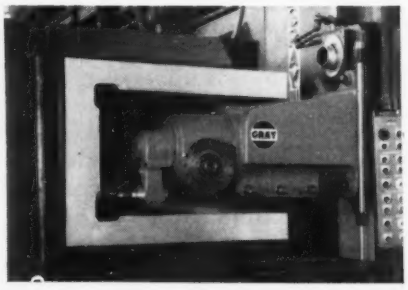




six different surfaces and more... and only ONE work-setting





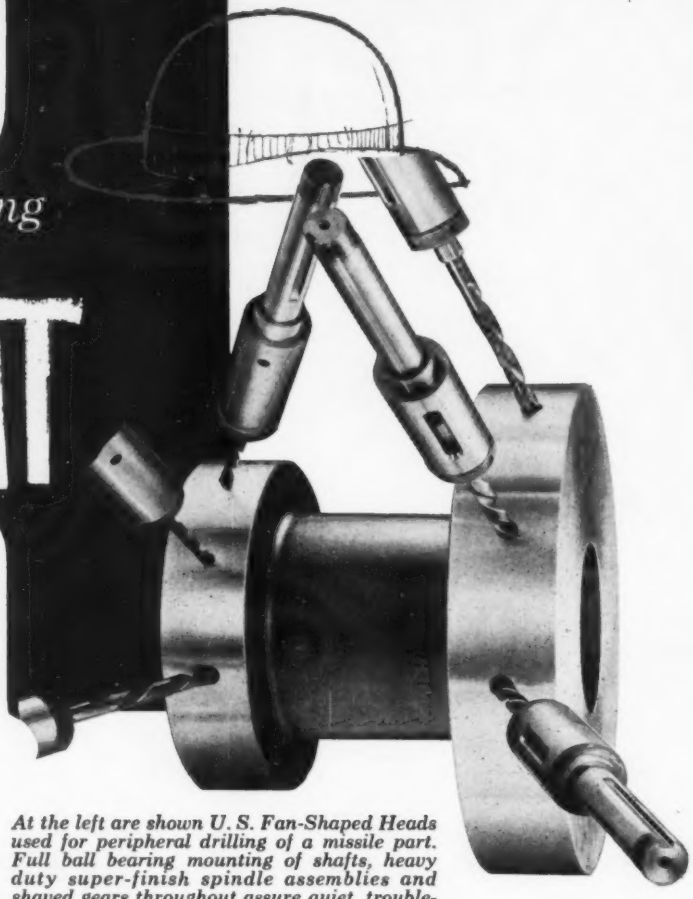


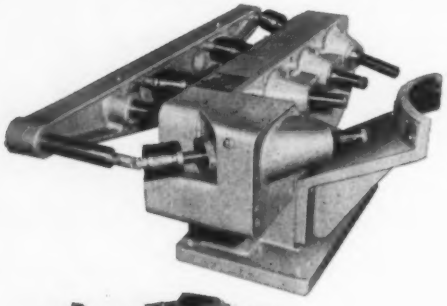
GRAY
GRAY
GRAY
GRAY

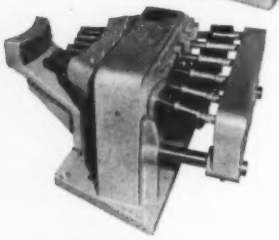
Peripheral Drilling
(even in missile parts)
is

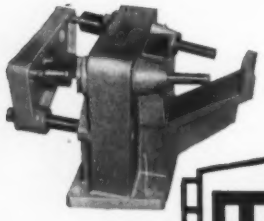
OLD HAT

to
U. S. Drill Head Engineers!









At the left are shown U. S. Fan-Shaped Heads used for peripheral drilling of a missile part. Full ball bearing mounting of shafts, heavy duty super-finish spindle assemblies and shaved gears throughout assure quiet, trouble-free performance . . . full torque and maintained drilling precision.

Maybe your PERIPHERAL DRILLING jobs aren't *exactly* like this, but U. S. Drill Head engineers can show you the cost-reducing way to do them. They did it for a missile manufacturer on a part that involved the same problems . . . and the profit-making setup included the U. S. *Fan-Shaped* Heads shown here.

This is "old hat" for U. S. Heads in automotive parts, diesel engines and many other industries, too. And now, with the space age continually bringing new products — new manufacturing problems — it will pay you to take advantage of U. S. Drill Head Co.'s leadership in applying cost-reducing multiple drilling and tapping heads.

Ask for recommendations on your particular drilling problems.

US DRILL HEAD

Adjustable and Fixed Center Multiple Drilling Heads.
Individual Lead Screw Multiple Tapping Heads.

UNITED STATES DRILL HEAD CO.

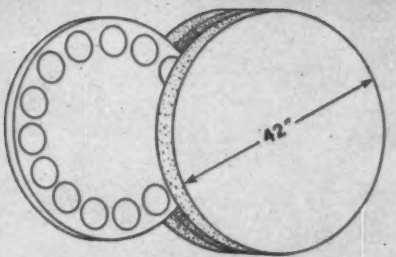
BURNS STREET • CINCINNATI 4, OHIO

For more data, circle this page number on inquiry card

new Gardner 2H40 precision disc grinder

larger discs . . . more power . . . greater capacity

40 hp drives
42″ discs



Rotary work carrier is illustrated. 2H40 is also available with thru feed or gun type fixturing.

New 2H40 Double Spindle Precision Disc Grinder

Greater accuracy—increased travel between larger discs improves flatness and parallelism.

Higher productivity—as much as 75% greater for parts over 6″ in diameter compared to 30″ disc grinder.

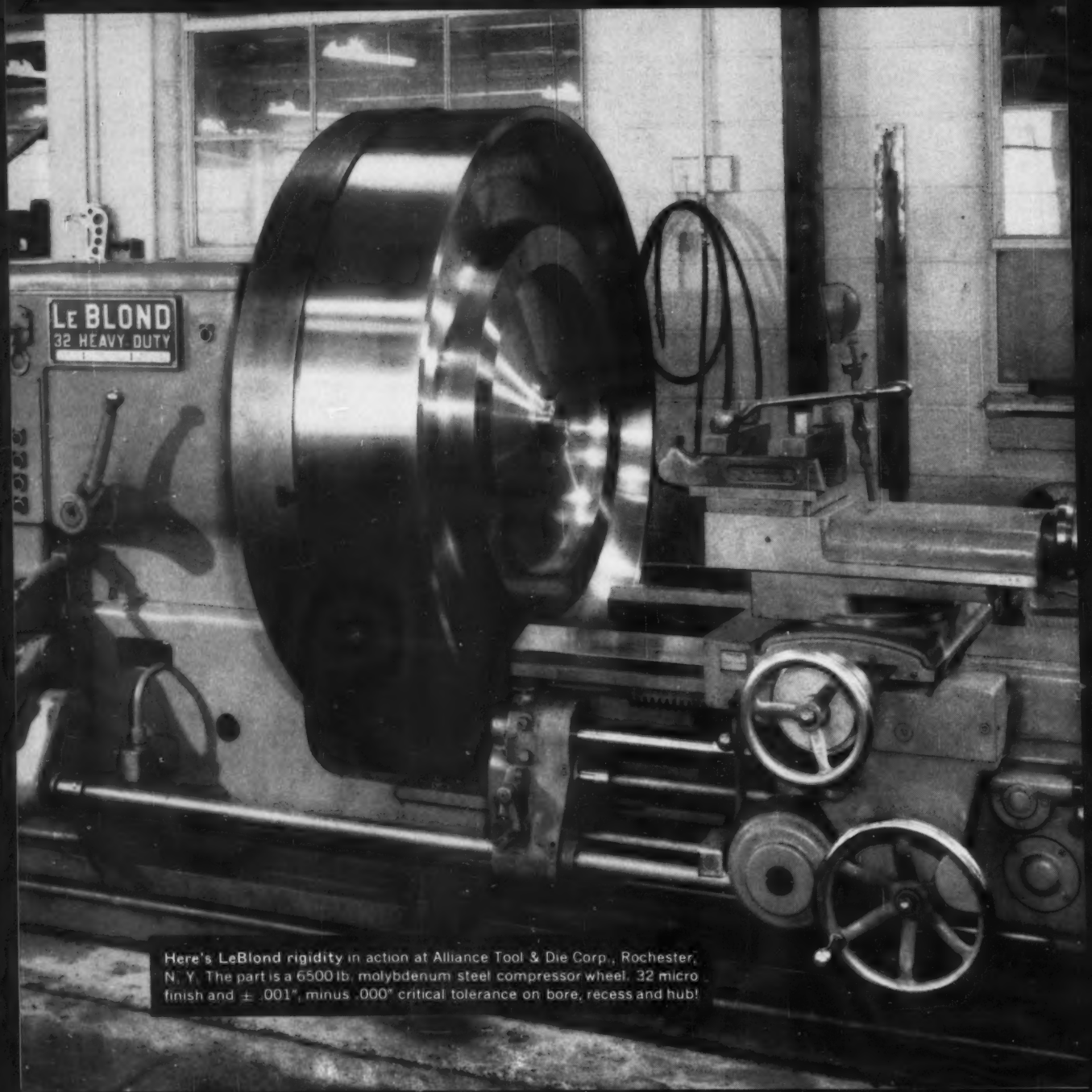
surface grinds **TWO** sides parallel in **ONE** operation

GARDNER

precision disc grinders

BELOIT, WISCONSIN

What is the BIGGEST



Here's LeBlond rigidity in action at Alliance Tool & Die Corp., Rochester, N. Y. The part is a 6500 lb. molybdenum steel compressor wheel. 32 micro finish and ± .001", minus .000" critical tolerance on bore, recess and hub!

workpiece your lathes can turn?

Probably your lathes will swing a 32″ piece. Or 40″. But what happens when that occasional 50″ or 60″ job comes along? Chances are you have to say, "We can't handle it. After all, how can you justify a big swing lathe, just for a few big jobs a year?"

Today there *is* a practical and economical solution to this odd-size work problem. LeBlond Sliding Bed Gap Lathes.

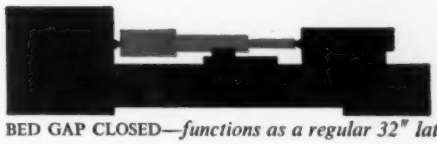
Our 32″/60″ Heavy Duty will accommodate work up to 60″ diameter! Basically this is a 32″ lathe. But it has an extendible bed (an upper bed that slides on a lower bed). Slide it to the right, and a gap opens. Now, you have a full 60″ swing! Also, for extra long work, there is 50% greater center distance. And the rest of the time you have a regular 32″ heavy duty lathe for a wide variety of work.

3 lathes in one—at the cost of a lathe and a half!

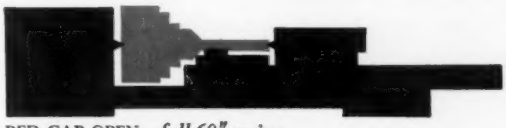
Here's an example of how this extra capacity pays off. Alliance Tool and Die Corp., Rochester, N. Y. are specialists in unusual machining problems, like precision molds—and the bulky compressor wheel, shown here. How did they turn it before? They didn't. The part was too big. Now, with their 32″/60″ LeBlond (recommended by Macaulay Machinery Co., Rochester, N. Y.,) they take jobs like this right in stride. Actually, this particular order was made possible by this lathe.

If you do job shop work, you can consider this lathe a business-getter. If you're doing your own maintenance, it gives you the capacity to do virtually all your own turning work. LeBlond Sliding Bed Gap Lathes are available in 4 sizes—16″/38″, 25″/50″ and 32″/60″ (shown) Heavy Duties and the 17″/28″ Regal. You're sure of getting the right lathe for your job when you buy LeBlond. There are 76 lathe models to choose from. Call your LeBlond Distributor or write.

Here's how the LeBlond Sliding Bed Gap Lathe gives you extra capacity for extra large work:



BED GAP CLOSED—*functions as a regular 32″ lathe.*



BED GAP OPEN—*full 60″ swing.*

BED FULLY EXTENDED—*50% greater center distance.*

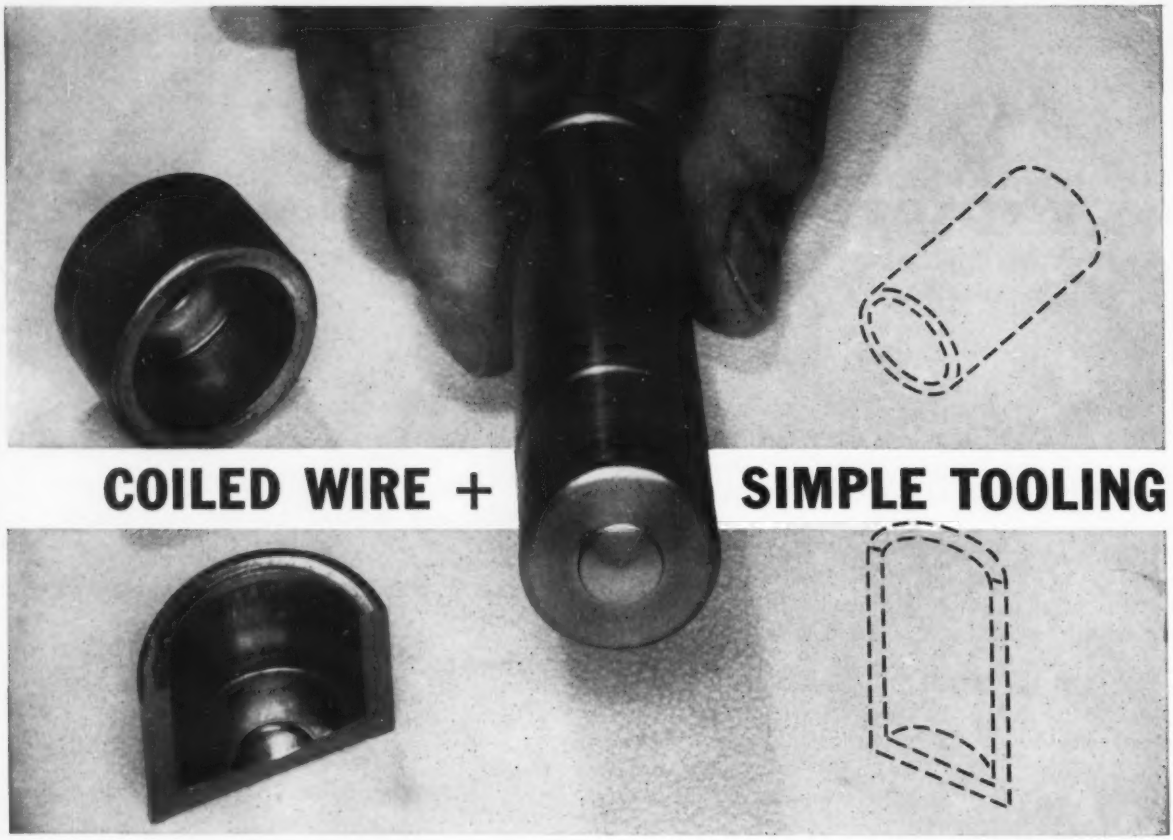
. . . cut with confidence

THE R. K. LEBLOND MACHINE TOOL COMPANY
Cincinnati 8, Ohio

LeBLOND of Cincinnati

World's Largest Builder of a Complete Line of Lathes for More than 71 Years

For more data, circle this page number on inquiry card

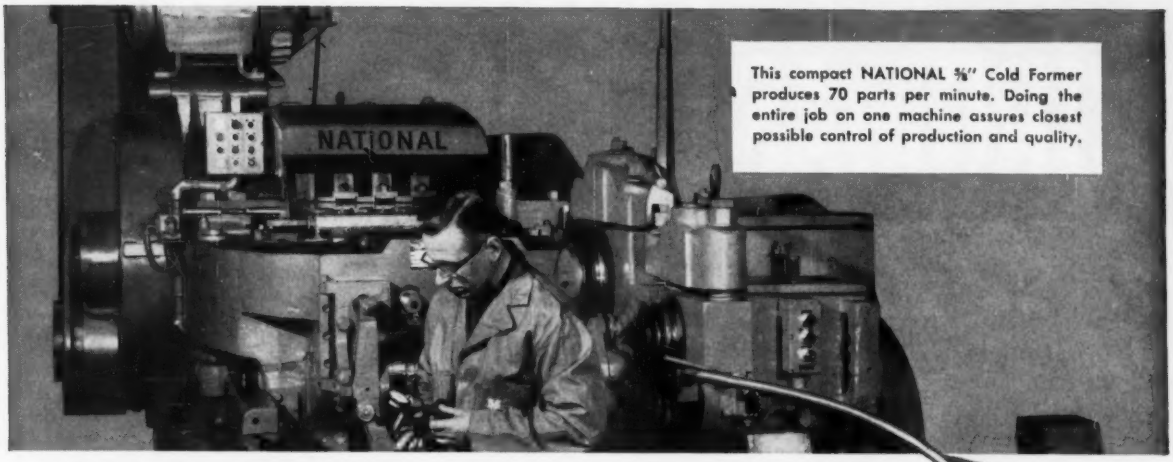


In cold-forming hollow parts from wire, the extrusion punch is the most critical and perishable element of the tooling. And yet, the typical steel punch shown above costs only a few dollars. Punch life for the universal joint bearing cup part is excellent.

Part "X" (name and illustration withheld at customer's request) is a deeper extrusion of higher-carbon material. Punch life for this practically-finished part is also remarkable even though the blanks – cut off from wire right in the Former – *are not end-coated!*

These are two more important cold-extruded jobs which forward-looking U. S. parts makers are now producing – automatically and successfully from coiled wire – on NATIONAL Cold Formers. No slugs to prepare, no in-between heat-treating or annealing, less handling, and many fewer operations.

PART	UNIVERSAL JOINT BEARING CUP	PART "X"
MATERIAL	C-1008 Drawn Coiled Wire	C-1016 Drawn Coiled Wire
MACHINE	3/4" NATIONAL Cold Former	1/2" NATIONAL Cold Former
PARTS PER MINUTE	60	80
EXTRUSION DIE LIFE	Practically Unlimited	Practically Unlimited
IS PART IN PRODUCTION?	Yes, at Pottstown Div. Dana Corp., Pottstown, Pa.	Yes, plant name and location withheld by request



This compact NATIONAL ⅝" Cold Former produces 70 parts per minute. Doing the entire job on one machine assures closest possible control of production and quality.

+ COLD FORMER = LOW COST PARTS!

WHAT IS THE BEST WAY TO DO AUTOMATIC COLD FORMING?

ANSWER: Produce from wire! Cold Formers and Progressive Headers are built upon our conventional Cold Nut Former and Boltmaker designs.

Is Material Expensive?

No. Coiled wire is low-cost material. (Of course, none is wasted by *forming*).

How Long Do Other Tooling Items Last?

Using bearing cup job as an example: Cutter and quill, hundreds of thousands of parts each; carbide die life is measured "by the millions."

What Preparation Does Coiled Wire Need?

None. You buy inexpensive drawn wire, ready to start into the Former.

How Do You Get the Initial Blank?

The Former cuts off accurately, and automatically transfers the blank from station to station until finished.

Do Physical Properties Measure Up?

They are excellent. Cold Forming actually improves them.

What About Labor and Floor Space?

Materially reduced. Verify by comparing Cold Forming with your present methods.

What Are the Biggest Advantages?

With the NATIONAL Cold Former you produce parts complete from coiled wire. You eliminate many operations and related handling problems. Result? More quality parts at lower production cost!

Can Your Jobs Be Made More Profitably by Automatic Cold Forming?
We Welcome You to Tiffin for a Discussion of Your Work

Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD DETROIT CHICAGO

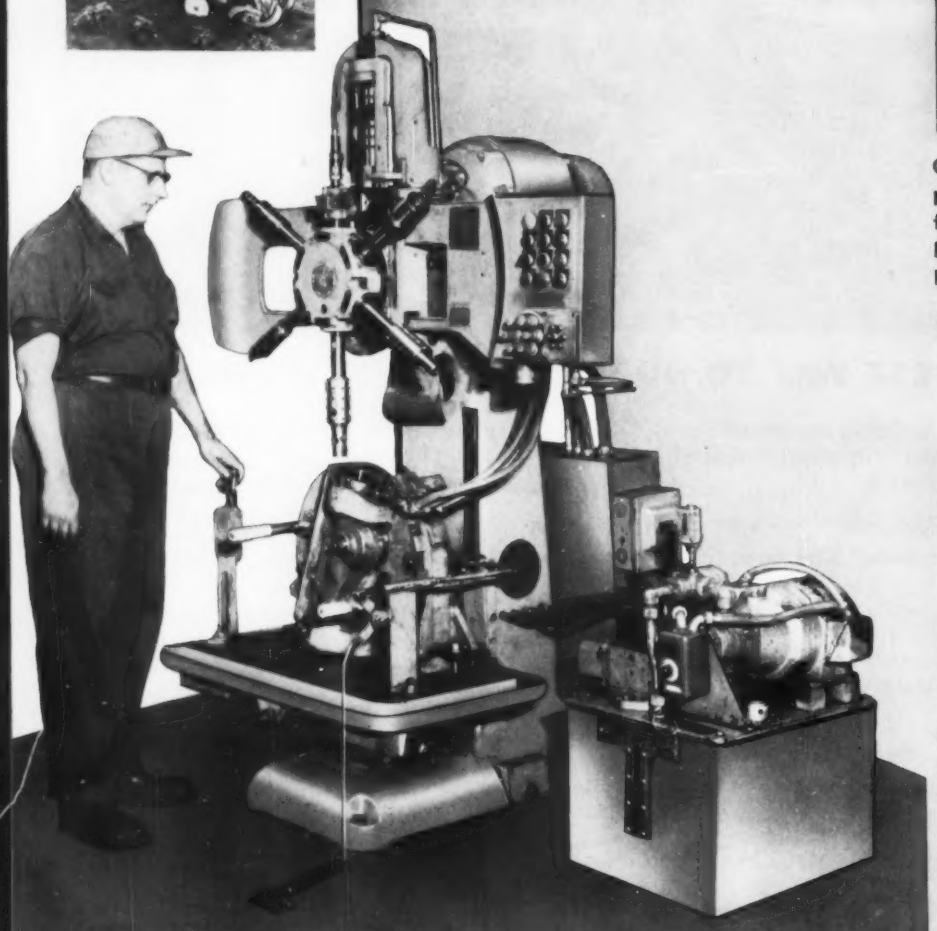
For more data, circle this page number on inquiry card

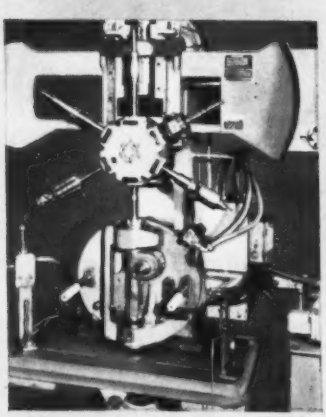
"Roticul" Parts Machined

BURGMASTER automatic hydraulic

Roticul Rotary Tiller is only one of the many power garden tools built by Simplicity Manufacturing Co., Port Washington, Wisconsin. Others include Wonder-Boy Riding lawn mowers, garden tractors, cultivators, spray equipment, etc.

Cast iron Roticul Rotary Tiller parts now machined three times faster on the Burgmaster Turret Drill over former turret lathe operation.





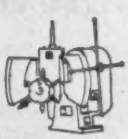
Close-up showing large carbide tipped multiple boring, reaming, grooving, c'boring, and spot facing tools with nylon wear strips. Not special 180° indexing fixture which is electrically safe-guarded for proper index position for respective tool.

Specialists in High Production Turret Drilling

"O" Manual Power Index ⅛" Capacity

1C Manual Power Index ⅜" Capacity

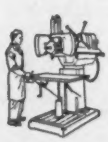
2B Manual Power Index ¾" Capacity



2BF Flange Mounted Power Index ¾" Capacity

2BH Automatic Hydraulic ¾" Capacity

3BH Automatic Hydraulic 1½" Capacity



2BR Ram Type Radial Drill ¾" Capacity

2BHT-3BHT Automatic Tape Controlled ¾" and 1½" Capacity

3 Times Faster....

6 SPINDLE TURRET DRILL

at Simplicity Manufacturing Company, Port Washington, Wisc.

Another example of good tooling on a Burgmaster Automatic Hydraulic Turret Drill pays off 3 to 1 in addition to a direct labor savings of $.147 per part. The cast iron housing was formerly machined on a turret lathe in 6.5 minutes, and is now machined on the Burgmaster in 2.3 minutes. Twelve operations are performed by special multiple cutting carbide tools on the 6 turret spindles. The tools have nylon wear strips and are piloted in steel bushings in the 180° and 15° indexing fixture. The fixture is electrically safeguarded to assure the proper index position for the respective tool. Burgmasters are pace-setters, automatically doing the work and the thinking — requiring only loading, unloading, and starting by pressing a button.

The efficient, automatic machine functions of the Burgmaster 2BH Turret Drilling, Tapping, and Boring Machines makes possible these production improvements. The turret is power indexed, permitting skip indexing, if desired, to provide different combinations of machining cycles. Spindle speeds and feeds are pre-selected and automatically shifted for each spindle to keep tools cutting at their optimum rates. Feeds are infinitely variable and quickly adjusted from standard controls.

In addition, accurate micro adjustable depth control for each spindle is provided, and automatic rapid approach and return saves valuable machine time and speeds the machining cycle. All operations are performed at the most efficient rate commensurate with fine finish, accuracy, speed and longest tool life.

Maximum Flexibility Is Assured

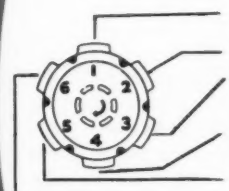
Because all machine functions are adjustable, the machine can be set up with different tools and fixtures in approximately one hour or less to produce other parts — automatically. This convenience permits some manufacturers to carry small inventories of parts.

Burgmasters may be supplied as complete production units, including fixtures and tools ready to go into production. With proper tooling, they will replace many different types of machines to effect substantial savings, increase production, and cut costs. Why not ask a Burgmaster field engineer to call? There is no obligation.

Job Facts

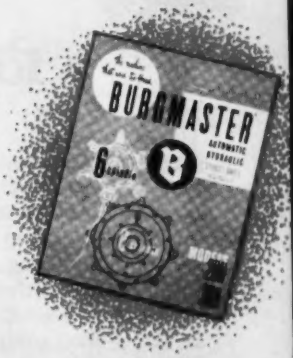
Machine: Burgmaster 2 BH Automatic Hydraulic Six Spindle (2 H.P.) Turret Drilling, Tapping and Boring Machine.
Company: Simplicity Manufacturing Co., Port Washington, Wisc.
Part: Cast Iron Housing for Rotcul.
Quantity: Continuous Production.
Fixture: 180° and 15° Indexing Fixture Electrically Safeguarded for proper Index Position of Port for Respective Tool.
Tools: Special Carbide Multiple Cutting, with Nylon Wear Strips.
Tolerances: .001 Bearing Bores; .002 Seal Bores.
Former Method: Turret Lathe
Former Time: 6.5 Minutes
Present Time: 2.3 Minutes
Savings: $.147 Direct Labor Per Part, Production Increased 3 to 1.

How The Job Is Run



Operations	Diameter	Speed	Feed
1. Ruf. & Fin. Bore, Spot Face Bearing Bore	1.800 1.844	1300	.008
2. Fin. Ream Bore	1.8504	1300	.012
3. Machine 2 Ring Grooves in Bore — Index Fixture 15° for Tapping Hole		720	.006
4. Tap Pipe Plug Filler Hole ⅜" Index Fixture 180° for opposite end		450	.055
5. Rug. & Fin. Bore & C'bore	.900,962 1.362	1300	.008
6. Fin. Ream & Counterbore	1.005, 1.375	720	.016

Write for bulletin describing Burgmaster 6 and 8 spindle Automatic Hydraulic Turret Drills in detail. Thirty-minute 16mm sound film showing Burgmaster turret drills in operation, including the new automatic positioning table, available from any Burgmaster office.



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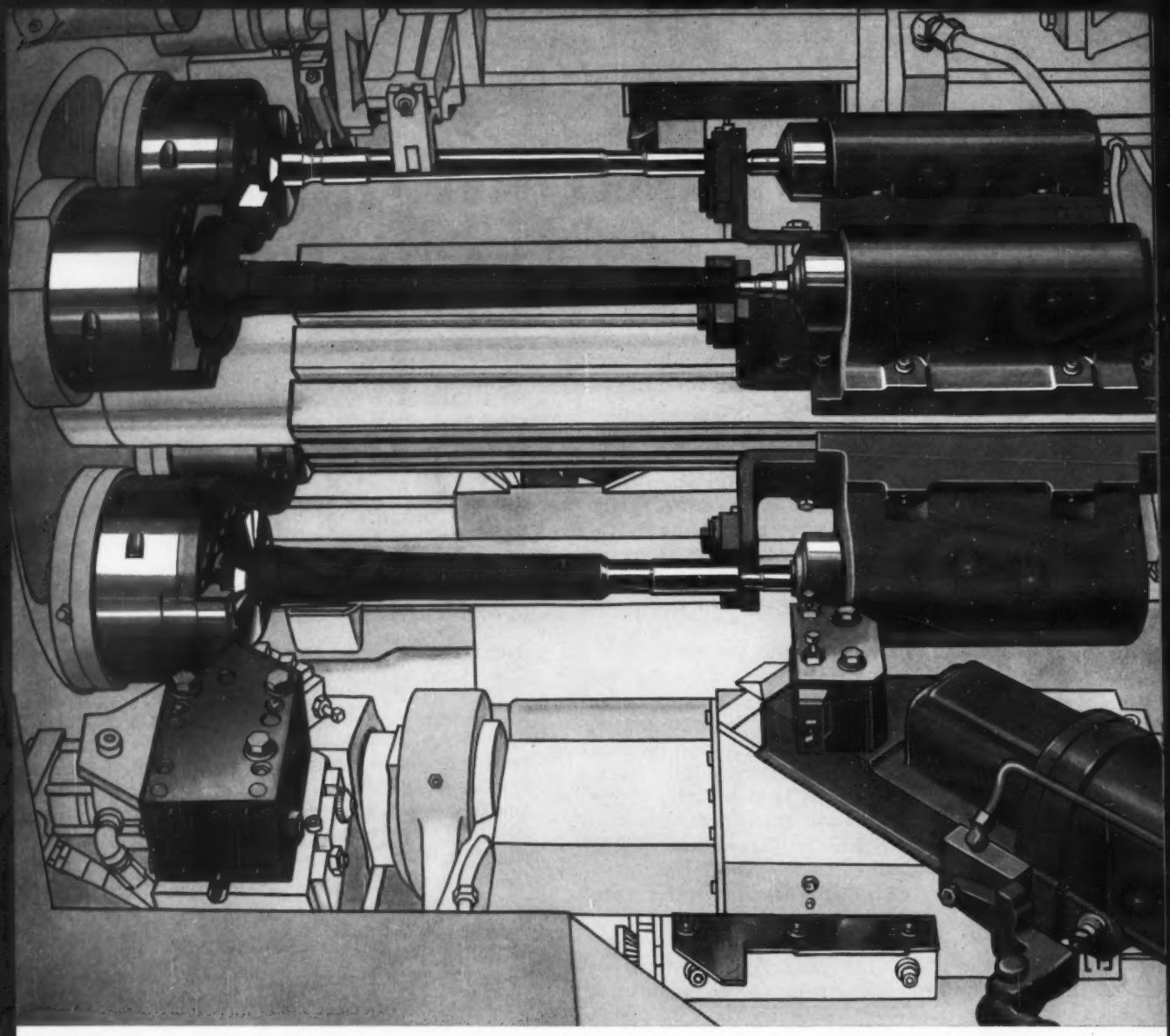


idea *for volume producers of shafts*

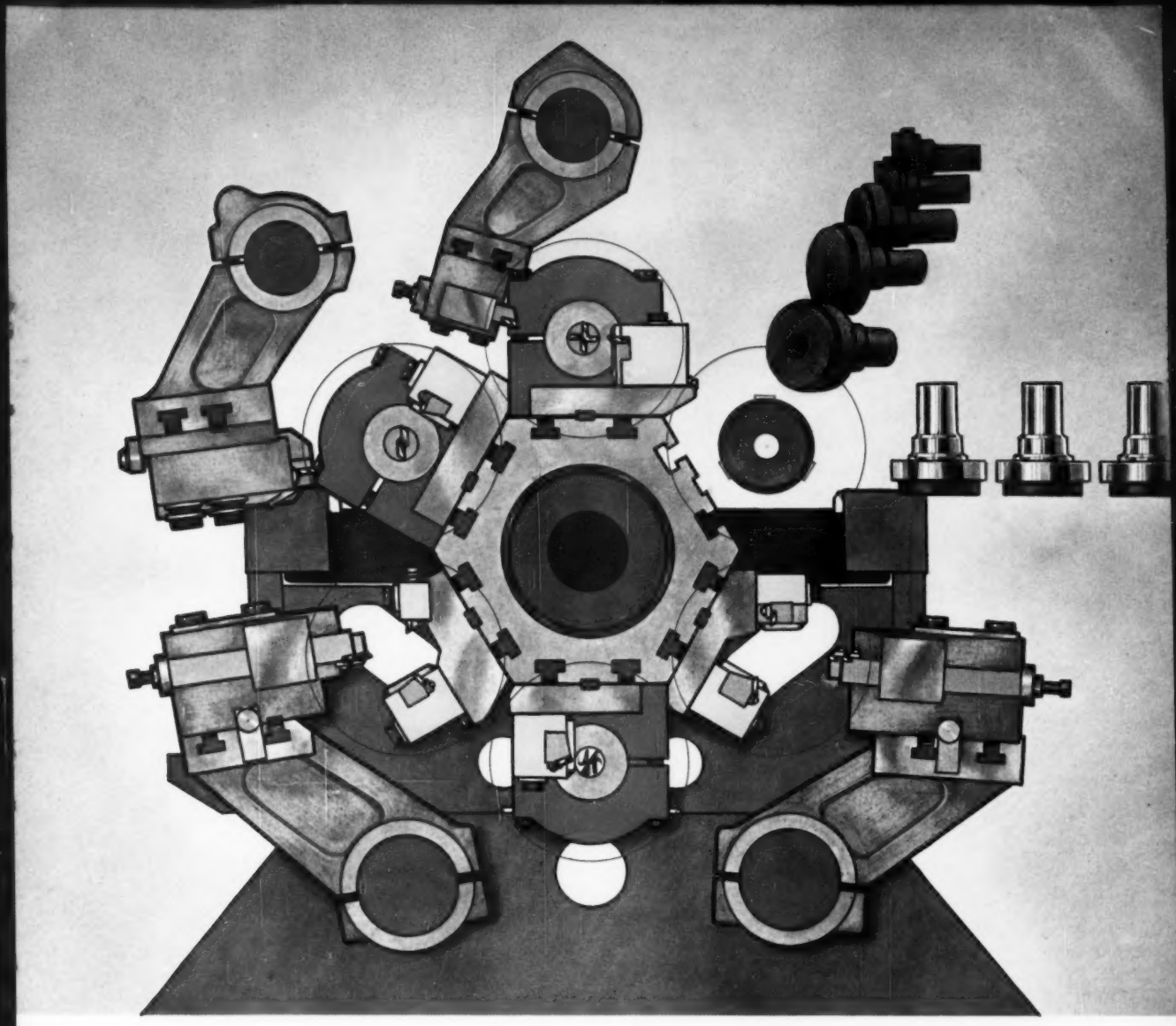
Economists are making startling predictions on this year's increase in productivity. They say it will be twice that of recent years – up as high as 10% in some manufacturing industries.

Whether or not these predictions come to pass, it's certain that it won't happen in plants using outdated equipment.

Shaft work is a problem to many firms. New Britain pioneered template-controlled contour turning and boring, solving the problem for many progressive companies. Now for the manufacturer with really high volume requirements we present Model 412/25—a four-spindle, template-controlled machine capable of producing a four-fold increase in productivity per man hour.

The basic principle pretty much speaks for itself. As in the case of the single-spindle contour lathe, inexpensive metal templates control the full cycle and re-cycle if required. Simple, single-point tools replace complex gang tooling. Set-up is simple and fast. When tools wear, merely replace them. Since all relationships are maintained by the template, tool replacement involves no problem.

When the volume of contour turning warrants it, this machine can be the best money maker on the production floor. Your New Britain representative can quickly tell you after looking at your prints and learning of your production requirements. Meanwhile, we would be glad to mail you descriptive literature containing the basic facts and specifications. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



two *approaches to the depreciation problem*

Until there is relief in the form of a more liberal tax depreciation policy, there's only one way to avoid the pinch of a shop full of over-age machines you can't afford to replace: *Buy machines that will stay new.*

If you are a user of New Britain chuckers you have seen their basic principles continue to stand as the most advanced design available, year in and year out.

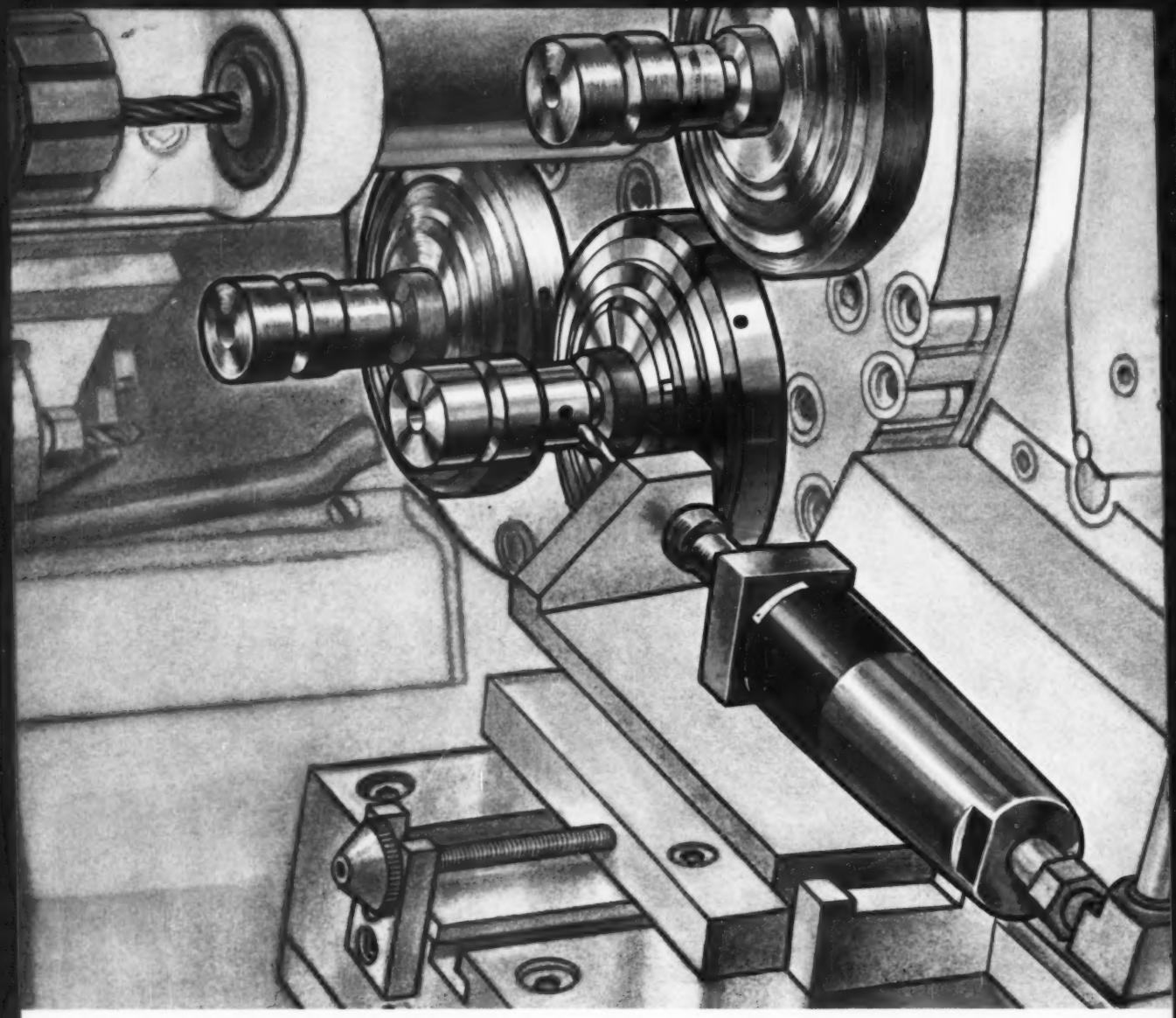
What value do you place on lifetime machine accuracy? The spindle carrier is the heart of a chucking machine. On a New Britain the carrier is lifted during index so it can't wear—then positively clamped to the frame during the cutting cycle for accurate cutting.

Interested in heavy facing and forming cuts? The long established New Britain swinging forming arm feature remains the best answer.

Want maximum clearance for fast and easy tooling, adjustment, and chip removal? Only New Britains are built with open end construction.

Today's New Britain chuckers provide the spindle speeds and power to take advantage of the most modern cutting tools. Optional tooling equipment includes drill speeders and attachments for reversing and non-reversing threading, recessing and accelerated reaming.

A new catalog describes the full New Britain line of 4-, 6- and 8-spindle, open-end, chucking machines. Fully illustrated in color, showing actual jobs, it may well suggest ideas for doing your work. Write for your copy. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



1960 productivity **now**

If you have a voice in the purchase of machine tools you have probably begun to think in terms of what will be on exhibit at next year's Machine Tool Show.

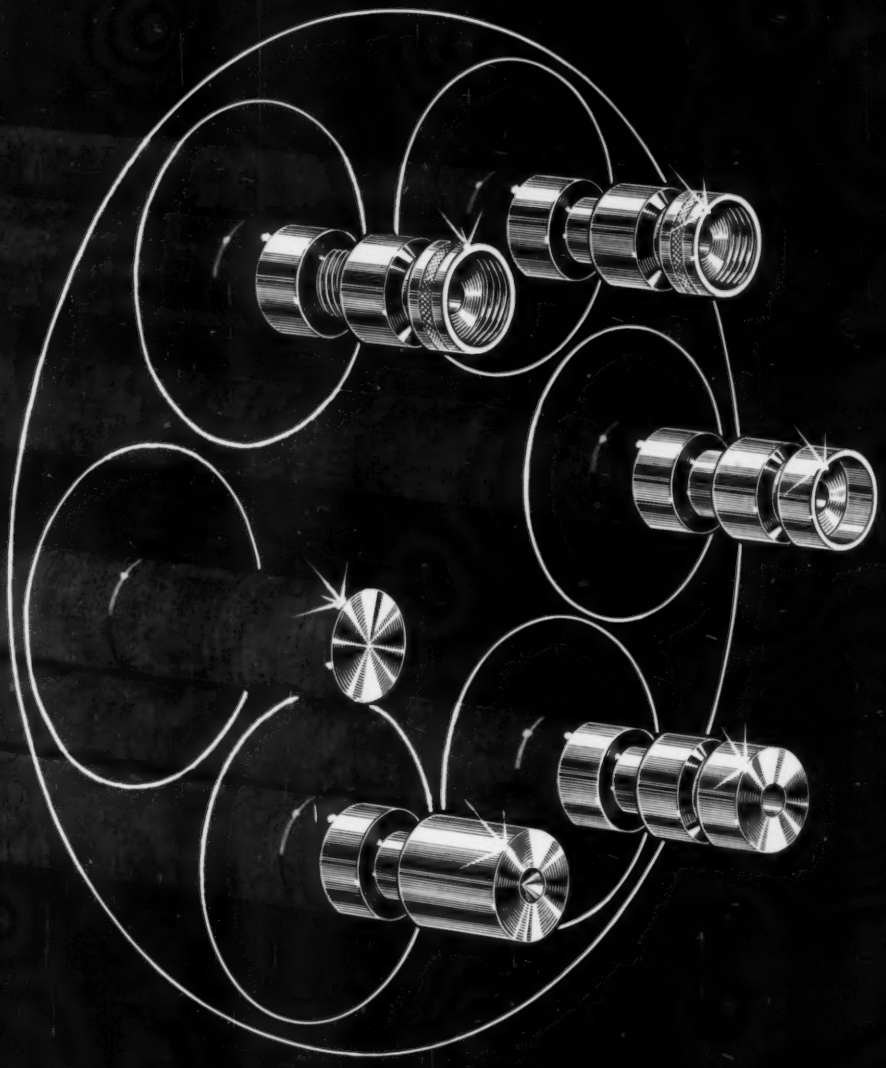
As far as multiple spindle bar work is concerned, you can see and buy and profit from the "show year" developments of New Britains a year ahead of time.

More operations, more pieces per hour, at closer tolerances has been the demand for years. Now New Britain has brought out a complete new line of bar machines that gives these words a brand new meaning.

Take the new Model 45 4-spindle series. The spindle capacity of 5" puts much larger pieces within automatic high-speed bar machine production range. Cross slides in all positions greatly increase the number and variety of cuts possible on four spindles. Spindle speeds up to 526 RPM provide for the use of the latest cutting tools. At the other extreme is a new line of 8-spindle machines. As you would expect with New Britain's radial independent cross slides, you can apply a tremendous number of tools and attachments to get very high production on really complex pieces. Or, with a double indexing set-up, you can turn out pieces, even pretty complex ones, at an all-time high rate per hour.

Six-spindle machines are everybody's work horses and New Britain offers the Model 52 in the 1¼" range, and the Model 62 with 2¼" capacity. These machines allow you to use a greater number and variety of tools on them without sacrificing accessibility. They can be tooled quickly and you can get at the tools for changes or adjustments with ease.

We can only suggest here some of the "show year improvements" in a greatly expanded line of New Britain bar machines. Your New Britain representative will be glad to arrange for a demonstration, and secure performance data based on your prints. If you would like to look over a catalog first, we'll be glad to send you complete descriptive literature. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Conn.



3½"—More **capacity** than ever in a New Britain

Model 82 • Six Spindles • 3½" Capacity • All New

Here is a *brand new* New Britain . . . the most modern large capacity bar machine available. The Model 82 brings to the 3½" size range all the versatility and exclusive New Britain features previously available only on smaller models. Designed from the ground up for large capacity work, the Model 82 is the only 6-spindle machine on the market that offers a really up-to-date replacement for the older, slower methods currently used for this size range.

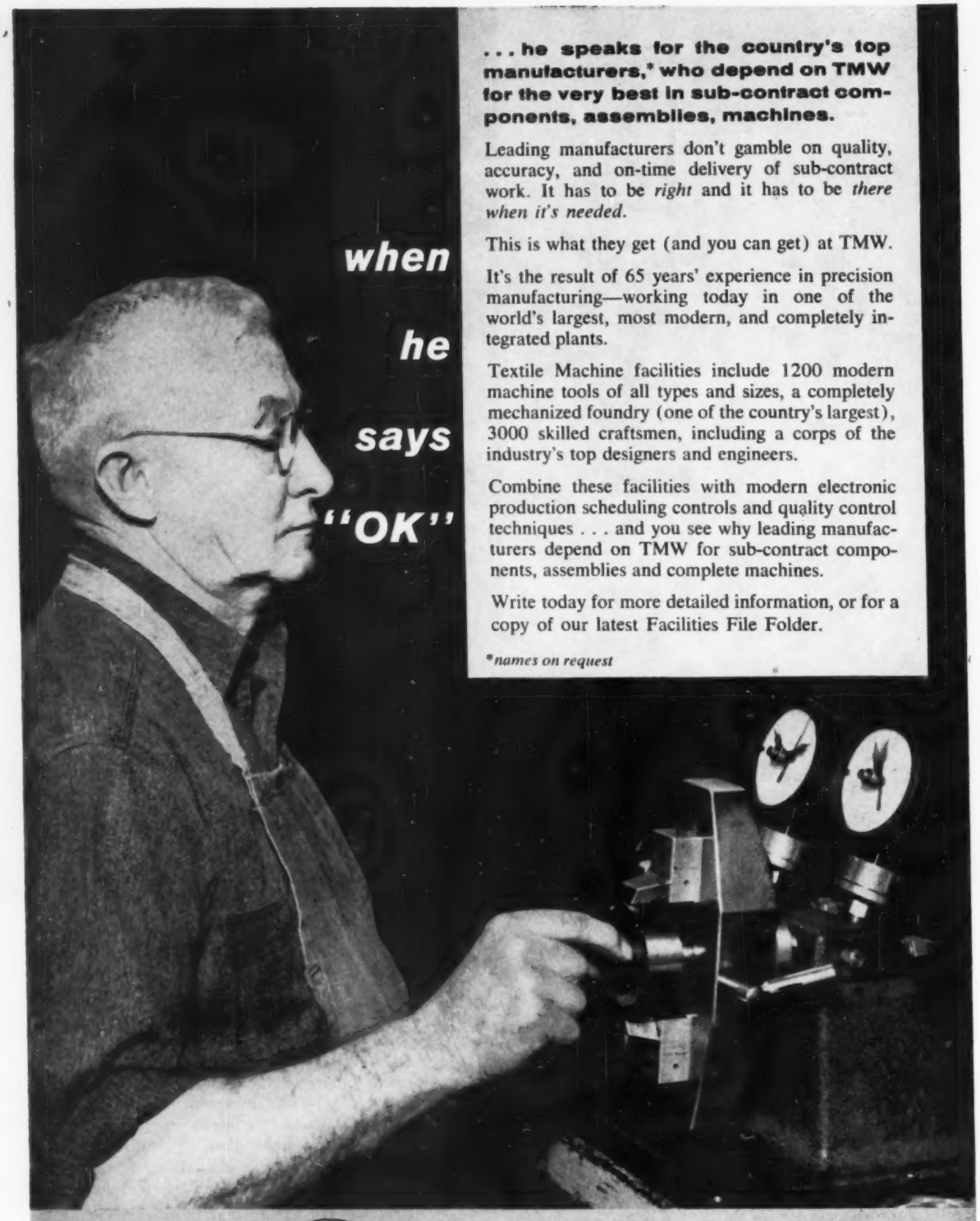
Each of the six spindles on the Model 82 has an independent, cam-operated cross slide. These cross slides combined with the end-working tool slide allow practically unlimited tooling combinations.

The Model 82, like all New Britain Bar Machines, has a special lifting and locating mechanism which prevents wear on the spindle carrier. Rigid locking of the carrier to the massive frame during the cutting cycle eliminates vibration.

The power, massiveness, speed range, accuracy, ease of changeover, coolant capacity and every other feature designed into the Model 82 makes this the right machine for high-precision, high-production, large-capacity bar work.

Why not investigate the possibilities the Model 82 offers in your plant? When you get right down to it, it's the first chance you've had in a long time to update production in an area that needs it badly. Complete catalog material is available on the whole range of New Britain Six Spindle Bar Machines. For your copy, write to The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

For more data, circle this page number on inquiry card



. . . he speaks for the country's top manufacturers,* who depend on TMW for the very best in sub-contract components, assemblies, machines.

Leading manufacturers don't gamble on quality, accuracy, and on-time delivery of sub-contract work. It has to be *right* and it has to be *there when it's needed.*

This is what they get (and you can get) at TMW.

It's the result of 65 years' experience in precision manufacturing—working today in one of the world's largest, most modern, and completely integrated plants.

Textile Machine facilities include 1200 modern machine tools of all types and sizes, a completely mechanized foundry (one of the country's largest), 3000 skilled craftsmen, including a corps of the industry's top designers and engineers.

Combine these facilities with modern electronic production scheduling controls and quality control techniques . . . and you see why leading manufacturers depend on TMW for sub-contract components, assemblies and complete machines.

Write today for more detailed information, or for a copy of our latest Facilities File Folder.

**names on request*

TEXTILE MACHINE WORKS
Contract Division • Reading, Pennsylvania

POSITIVE DUPLICATION – EVERY TIME!

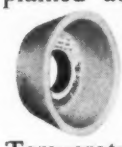
From a given point, the needles of these compasses always point to the earth's magnetic poles . . . an important aid to exploration and navigation.

The (PD)° marking on these CINCINNATI Surface Grinding Wheels (and *all* CINCINNATI WHEELS) points to an important and remarkable quality . . . Positive Duplication, time after time after time.

CINCINNATI (PD) WHEELS do a better job for you, because 36 separate quality control steps in the unique (PD) process result in wheels of unsurpassed uniformity.

UNIFORMITY TO YOUR ADVANTAGE

Perhaps every wheel manufacturer has complained about the weather and its changing effects on the product. But Cincinnati has followed Mark Twain's advice and has done something about the weather.



Temperature and humidity of the Mold Room are controlled at exact, unchanging levels—every hour of every day *throughout the year!* In addition, (PD) vitrified wheels are fired in a tunnel in unvarying conditions of atmospheric control at critical sections within the kiln.

Result: Each of your re-order (PD) wheels will act and grind exactly like the original wheel.

CALL CINCINNATI

For experienced help in cutting costs, in grinding machine setups and operations, there are Cincinnati grinding specialists available to you. Call your CINCINNATI (PD) GRINDING WHEELS distributor, today, or contact Cincinnati Milling Products Division, Cincnnati 9, Ohio.

(PD) POSITIVE DUPLICATION

CINCINNATI°
GRINDING WHEELS

°Trade Mark Reg. U.S. Pat. Off.

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

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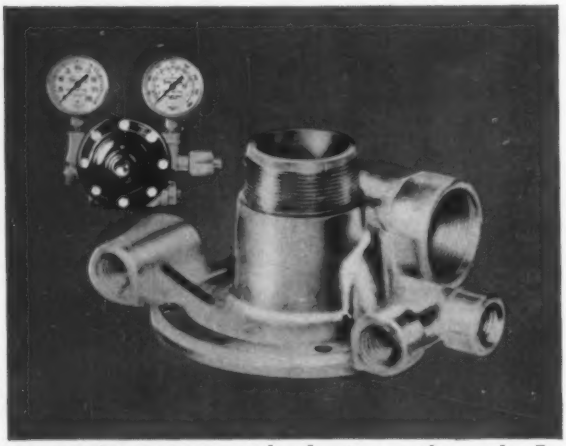
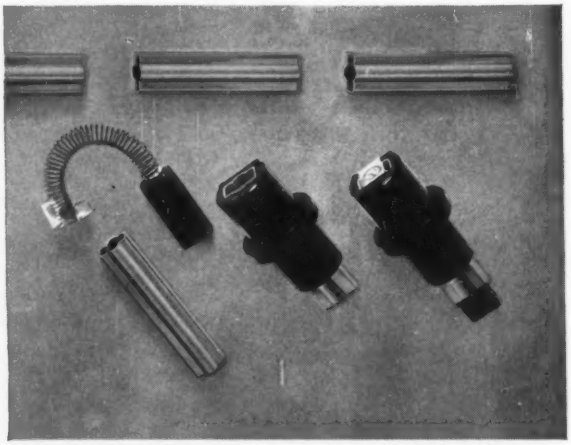
TAKE A FRESH LOOK at the way you are fabricating metal parts. Cost-cutting possibilities are almost unlimited with these Anaconda pre-formed mill products and press products.

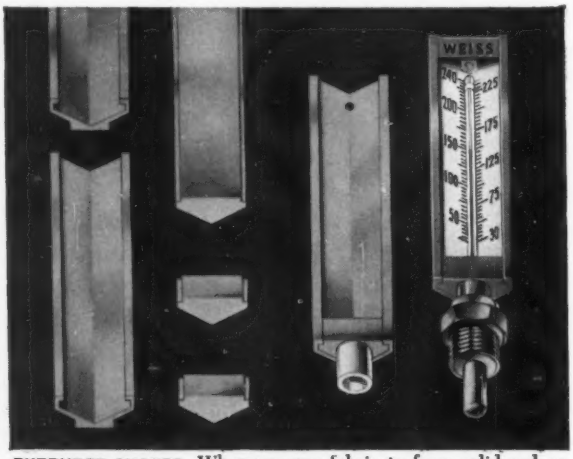


DIE-PRESSED FORGINGS, made of twice-wrought metal, offer superior uniformity, denseness, accuracy. *Savings*: replace more costly built-up assemblies—often are less in first cost than sand castings—require minimum surface machining to size—simplify secondary operations—lower tool cost—lower finishing cost.



SPECIAL-SHAPE TUBES can, as in the case of Electrolux, save several steps in arriving at a finished part. Brass electric-motor brush holder (above) is cut economically from long lengths of tube pre-shaped to accommodate both brush and spring. Uniform accuracy of all dimensions helps provide good brush stability.

MULTIPLE-PLUNGER AND PROGRESSIVE-TOOL-PRESS PRODUCTS are cutting costs throughout industry—often over 50%. Main reasons: The American Brass Company's complete design engineering service, long experience, specialized production equipment, a big selection of stock tools. Metals: copper, copper alloys, nickel, iron, steel, stainless steel, or aluminum.



EXTRUDED SHAPES. Wherever you fabricate from solid rod or bar—or castings—consider savings in machining, tooling and scrap by use of extruded shapes. Albert A. Weiss & Sons substituted two extruded shapes, above, for a sand casting—cut cost of thermometer case 41%, got an additional 30% saving in assembly because of consistently uniform dimensions.

HERE are four immediate approaches to cutting costs. Re-evaluate your designs and fabrication methods with these short cuts to finished products in mind. Wherever you spot a possible saving, send a sample, drawing, or description—with the quantity you need, the metal or properties you require—and ask for a quotation. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Limited, New Toronto, Ontario. 5853

DIE-PRESSED FORGINGS • SPECIAL-SHAPED TUBES
EXTRUSIONS • FABRICATED METAL GOODS

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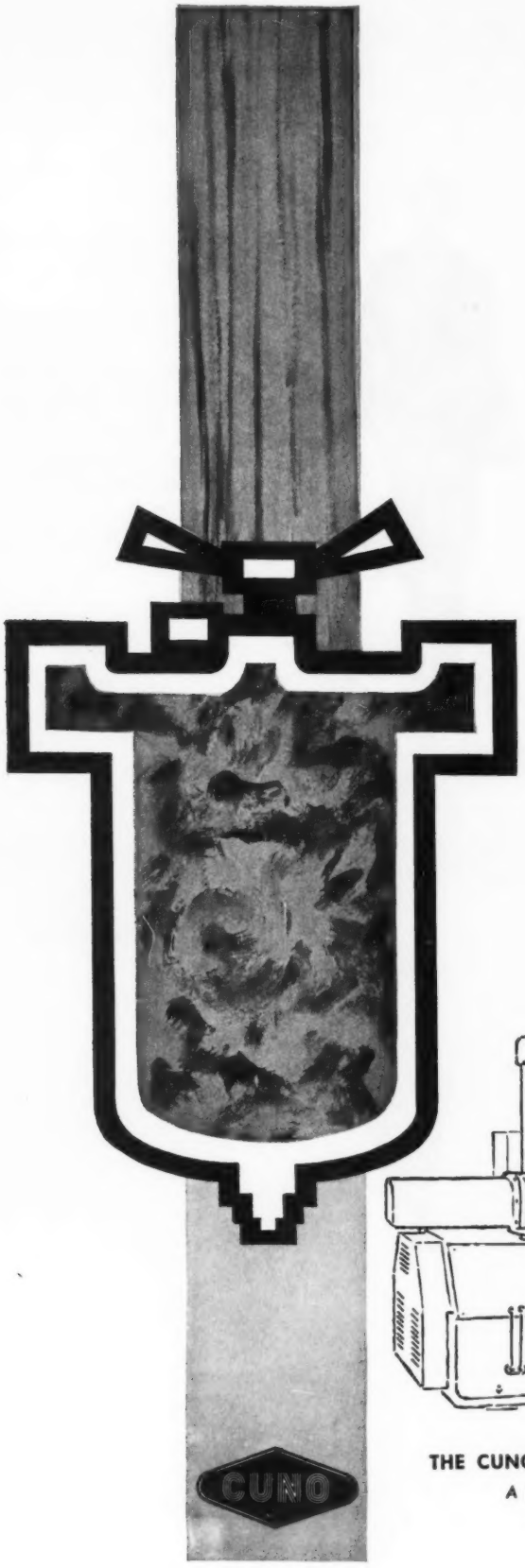
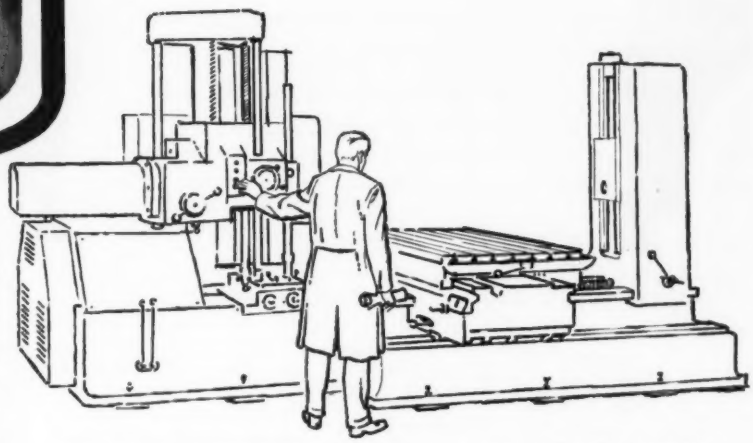


whatever the **machine tool application . . .** you can depend on **CUNO** engineered filtration

CUNO Filters are vital to the efficient operation of machine tool lubrication, hydraulic, and coolant systems. By removing damaging particles, they help reduce maintenance and replacement costs by protecting bearings, gears, valves, pumps, controls, etc. . . . help improve the quality of the product being manufactured.

Depending upon the specific application, CUNO offers you three basic filter types . . . CUNO Positive Self-Cleaning Edge-Type, CUNO Automatic Self-Cleaning Wire Wound Type, CUNO Disposable Depth Cartridge Filter . . . available in a variety of housings to meet *any* flow requirement.

Whenever *you* have a filtration problem—involving either a built-in application or a centralized system—write us. Our engineers will welcome the opportunity to demonstrate how you can *depend on* CUNO.



THE CUNO ENGINEERING CORP., Dept. 11, MERIDEN, CONN.

A Leader in Industrial Filtration for More Than 30 Years

In Canada: Peacock Bros., Ltd., P. O. Box 1040, Montreal 3, P.Q.

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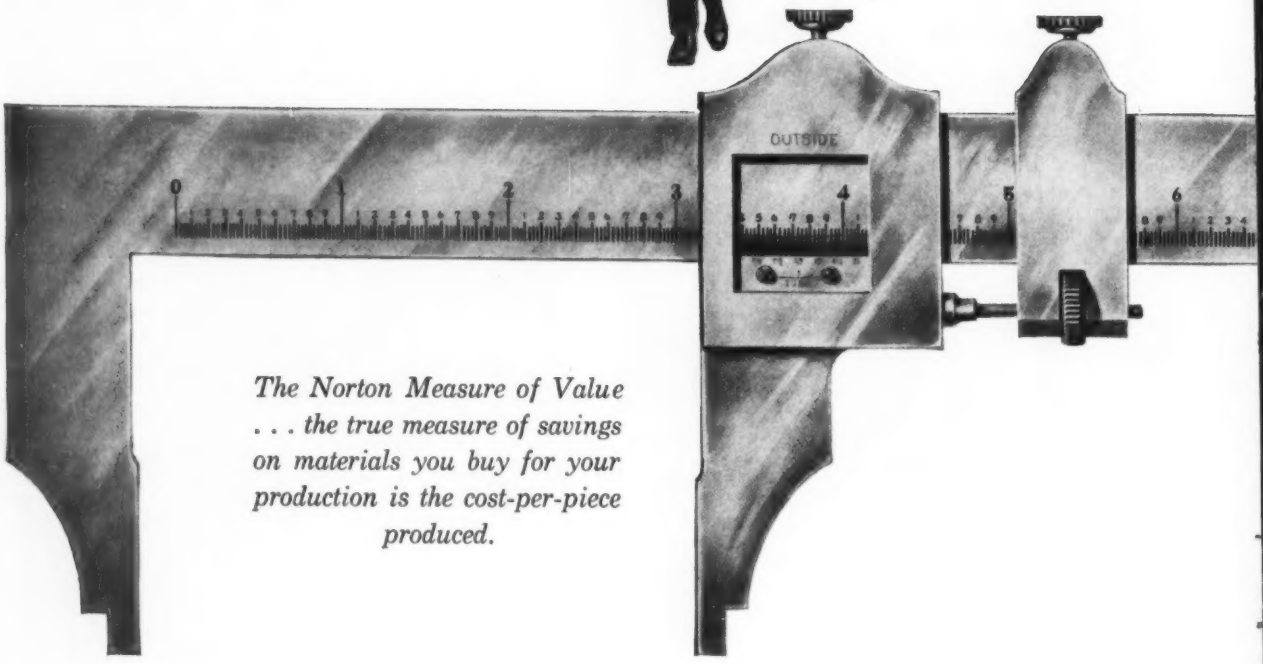
Call your Norton Man — he has the experience, the products, and knows how to save you money where it counts. There's a Norton expert in the fields of — abrasives, grinding machines, refractories.



The Norton Measure of Value . . . the true measure of savings on materials you buy for your production is the cost-per-piece produced.

Economists could argue the definition of the value of a grinding wheel in many ways. But it would usually come down to this — What is it worth to the purchaser.

You can buy less expensive grinding wheels than Norton wheels and save on immediate cost. But if the lower cost wheels do not perform their jobs efficiently or cause production delays because of poor quality or wheel misapplication — you haven't made a bargain — you've made a costly mistake.

The only accurate measure of the value of a grinding wheel is how much it produces for you per dollar cost — not merely how much you paid for it. Here is why Norton grinding wheels are worth more to you —

Norton Company gives you the most advanced research engineering and manufacturing facilities in the entire abrasive field — and you get this great scope of detailed knowledge on a personal basis — your Norton Man.

Every Norton Man starts his career by spending a minimum of one year in a carefully planned training course in the Norton plant and a comparable period of training in the field to assure a broad, thorough understanding of grinding before he goes "on his own." The average experience of all Norton Men in the field is 15 years in addition to their specialized training. The Norton Man is the most knowledgeable man in abrasives that you can consult. Make him your consulting abrasive engineer.

He will make an Abrasive Requirement Study for you.

You can produce greater savings than you can buy

This study lists the correct specifications for each abrasive job in your plant to assure you lowest cost-per-piece produced. He is also available for complete field testing on specific problems.

For example, your Norton Man can increase production by pointing out ways for better wheel usage and fewer wheel changes. He has the widest selection of grinding wheels in the industry from which to select the best wheel for new product grinding operations and for improving your current grinding jobs — both at the lowest cost. And with Norton grinding wheels you can be sure of precise duplication order after order.

Norton offers true abrasive economy. Economy that pays off in lower cost-per-piece produced. Call your Norton Man. NORTON COMPANY, General Offices, Worcester 6, Mass.

W-1893

NORTON
ABRASIVES

Making better products... to make your products better

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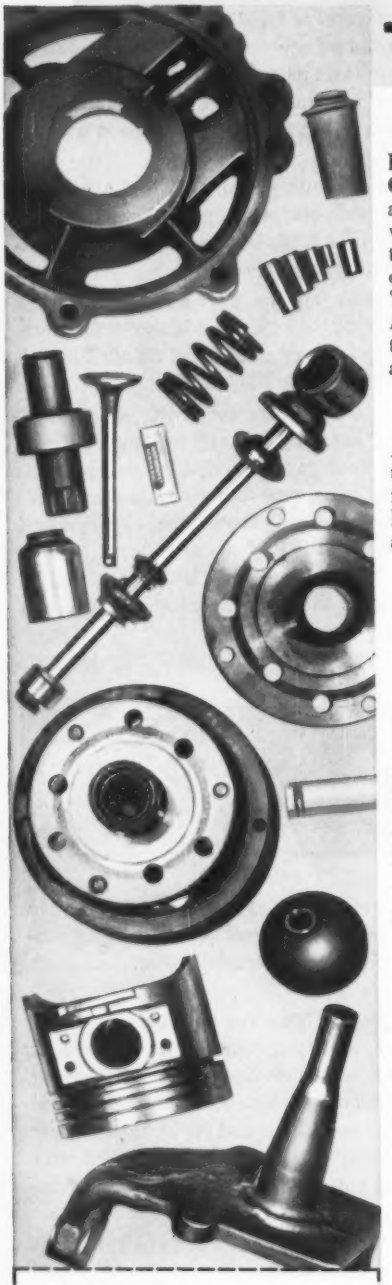
..... practical automation ideas



Portable Demand-Feed Storage

For plants operating on a job-run basis, Gear-O-Mation has recently developed a number of portable storage units which can be quickly rolled into position at various machines to provide demand feed. One such unit has storage 'containers' for several sizes of parts. An important advantage: parts are protected against damage in handling into and out of storage and at the machine.

Simple Locating Shuttle

A simple walking beam device permits the quick shuttling of large castings from one machine or line to another, locating the part in the second machine automatically in the same motion.

Gear-O-Mation Division was organized in 1956 to develop and build highly practical automation equipment GEARED TO EITHER EXISTING OR NEW PROCESSES AND MACHINES—whether already in use or new.

Automated Handling of Fragile Parts

Fragile parts can be handled between operations without danger of injury by a conveyor with removable pallets. The pallets carry the work to the proper place and then return to the starting point on a separate conveyor. A typical use: manufacture of grinding wheels.

No Electrical Units

A combination parts-accumulator, storage device and demand feeder has no electrical connections or devices. Servicing of parts elevators, escape mechanisms, sensing devices, etc., can be be done with a couple of wrenches and a screwdriver. All controls and operating units are pneumatic.

It is the policy of Gear-O-Mation to use only proven mechanical, pneumatic, hydraulic or electrical devices in its automation equipment. This minimizes chances of service interruptions and insures minimum cost consistent with reliability and performance.

"Wash Just Before Use"

Demand-feed storage units can be combined with integral parts washers in such a way that parts can be cleaned as they go into storage or just before they come out, or both. Best practice seems to be: clean parts shortly before they pass on to the next operation.

The success of Gear-O-Mation's "simplicity" policy is attested to by the successful operation of Gear-O-Mation equipment in a wide variety of industries and both continuous or job-lot types of plants.

Irregular Parts Can Roll Too

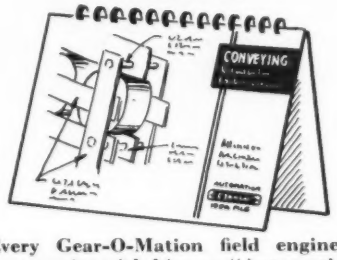
Parts that are notched and have a tendency to interlock can be fed by gravity without difficulty provided the proper chute angle is used. At Gear-O-Mation we don't depend on 'paper calculations' for this. 'Adjustable angle' gravity test chutes are used to find the best chute angle to avoid interlocking and yet feed parts at minimum rolling speed to avoid damage.

To automate you do not need to spend fortunes. Nor do you have to go in for complex electrical or electronic control. Frequently the simplest solution is the best. That's Gear-O-Mation's philosophy. Yes, we know, it often takes more ingenuity to do things simply rather than by complex devices. But that's our stock in trade—INGENUITY.

Cleaning-Up Boosts Output

Experience shows that where handling of parts is automated, the increased plant cleanliness alone tends to boost production more than would be expected from the automation alone. Some plants get increased output simply by "getting everything off the floor".

NEW "IDEA FILE"



Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting, feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon at left.

GEAR-O-MATION
Division of Michigan Tool Company
7171 E. McNichols Rd., Detroit 12, Mich.

Yes! I want to see the time- and money-saving ideas in your new "Idea File." Have your field engineer show it to me soon!

Name_____

Company_____

Street_____

City_____

GEAR-O-MATION
DIVISION OF MICHIGAN TOOL COMPANY
7171 E. McNICHOLS RD. • DETROIT 12, MICH.

For more data, circle this page number on inquiry card

a tiny milling cutter

a broach of

largest size

the quality is identical because the steel is VANADIUM-ALLOYS

Photo Courtesy National Broach & Machine Co.

HIGH SPEED STEELS

- Vasco Supreme
- Vasco M-2
- Van Lom
- Red Cut Superior
- Neatro
- Van Cut
- 8-N-2

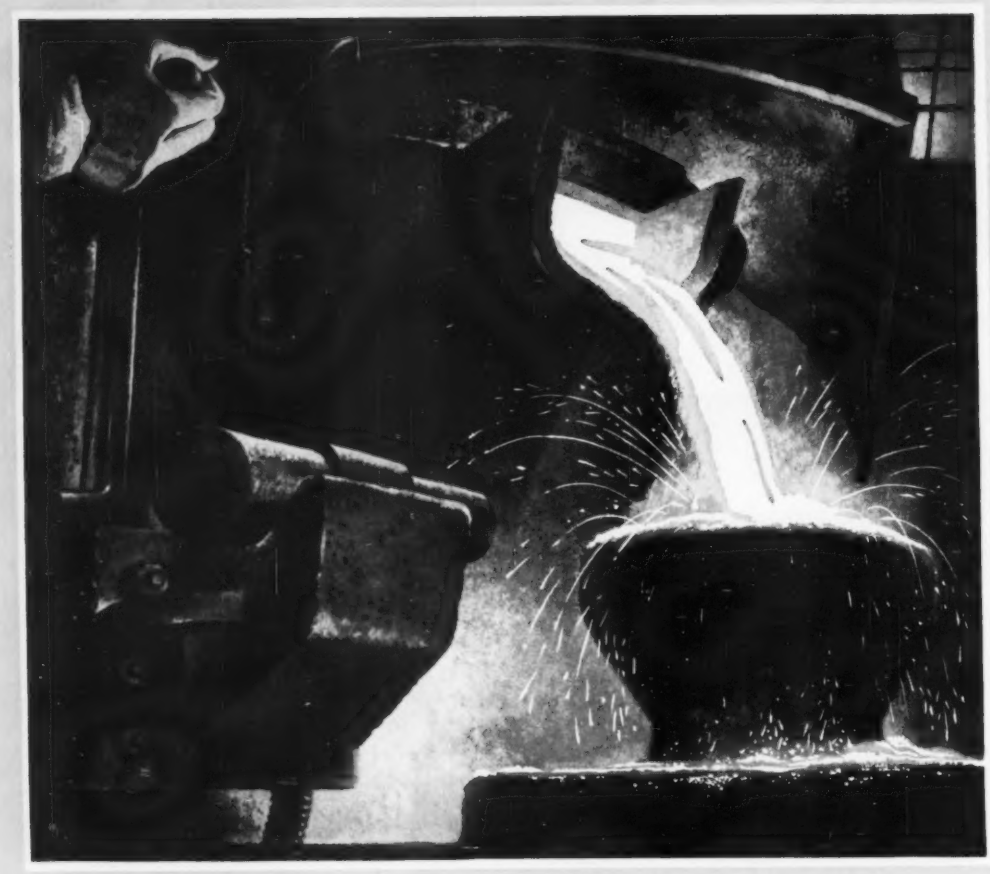
FIRST QUALITY has a diamond-clear meaning when applied to our steels. It is a term expressing guaranteed excellence in a ⅜" bar from which thousands of miniature milling cutters are made—and equally in a bar from which may be machined the largest broach you care to produce. Sound steels for profit-making tools, in a complete range of grades, shapes and sizes. Let a Vanadium-Alloys' sales engineer consult with you on your needs.

V·A

Vanadium-Alloys Steel Company

LATROBE, PENNSYLVANIA

DIVISIONS: Anchor Drawn Steel Co. · Colonial Steel Co. · Metal Forming Corporation · Pittsburgh Tool Steel Wire Co. · **SUBSIDIARIES:** Vanadium-Alloys Steel Canada Limited · Vanadium-Alloys Steel Societa Italiana Per Azioni · EUROPEAN ASSOCIATES: Societe Commentryenne Des Aciers Fins Vanadium-Alloys (France) · Nazionale Cogne Societa Italiana (Italy)



Melting furnace at Calumet & Hecla, Inc.—Wolverine Division, where Shell Irus Fluid 902 eliminates the danger of hydraulic line fires.

Ready... aim... NO FIRE!

Take 10 high-temperature alloy-melting furnaces, hydraulically operated—each pouring 1500 lbs. of molten metal every hour in close proximity to "live" hydraulic lines—and you can readily see why selection of hydraulic fluids is important to Calumet & Hecla's Wolverine Tube Division.

Now the operation is made more reliable by the use of Shell Irus Fluid 902, a water-in-oil emulsion type fluid. Irus® Fluid was C & H's choice, after carefully studying other commercial hydraulic fluids—for many reasons:

1. Irus Fluid will not support combustion.
2. Irus Fluid has excellent lubricating properties.
3. Irus Fluid has hydraulic efficiency and equipment compatibility.
4. Irus Fluid is economical, costing about one-third less than other fire-resistant fluids.
5. Irus Fluid's bright yellow color makes it easy to spot and trace leaks.

In plant after plant, operators find that these advantages assure maximum safety to both personnel and equipment.

If you have a hydraulic line fire hazard, we suggest that you have the Shell Industrial Products Representative show you the many advantages in Irus Fluid 902; or write to Shell Oil Company, 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif. In Canada: Shell Oil Company of Canada, Ltd., 505 University Ave., Toronto 2, Ontario.

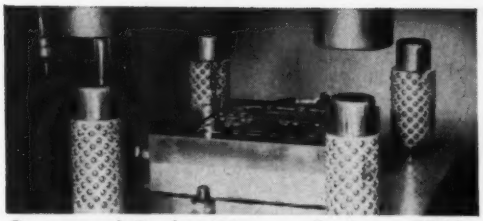
SHELL IRUS FLUID 902

the low-cost, fire-resistant hydraulic fluid

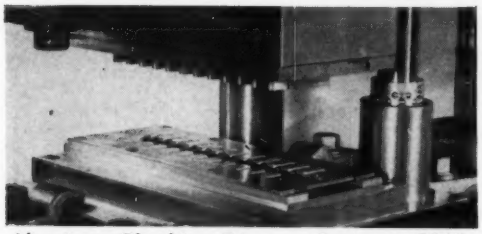
SHELL

eloxing

will put you ahead of competition



Compound Gasket Die . . . Savings: 20%



Aluminum Blanking Die . . . Savings: 50%

Cold Heading Die . . . Savings: 30%

Track Link Forge Die . . . Savings: 25%

15% to 50%

when you make or use similar dies . . .

Die Cast Die . . . Savings: 25%

Powdered Metal Die . . . Savings 25%

Eloxing is a term used to designate machining performed on precision equipment manufactured by the Elox Corporation and which carries the registered trade mark *"ELOX"*.

For detailed information on how you can benefit by these jobs, write or phone . . .

elox *corporation of michigan*

Pioneer Developers of Electrical Discharge Machining

1833 N. Stephenson Highway Troy, Michigan

MUlberry 9-1921

For more data, circle this page number on inquiry card

only *Lapmaster* would guarantee a flatness of ±.00005″ on parts weighing 4920 lbs.

Proper functioning of this vital missile tracking equipment required the highest degree of accuracy obtainable in flatness and parallelity on several component parts . . . some of unusual weight and size. Of all the precision machine tool manufacturers asked to submit recommendations and quotations, only the Lapmaster Division of Crane Packing Company would guarantee to meet the tolerances.

Handling large and odd shaped parts was not new to the Lapmaster. Standard Model 84 Lapmasters had long been lapping to flatness within three light bands (.000035″) on large castings. Therefore only a few modifications to the standard Lapmaster 84 were required to take care of the 4920 lb. 84″ diameter weldment (see job data).

This job also required a machine with the versatility to handle a variety of small parts as well as the big ones. This customer found—as hundreds of users have—that size, shape or form is no problem to a Lapmaster.

On any job—flatness of the lap plate is continuously maintained by the patented reconditioning action of the conditioning rings.

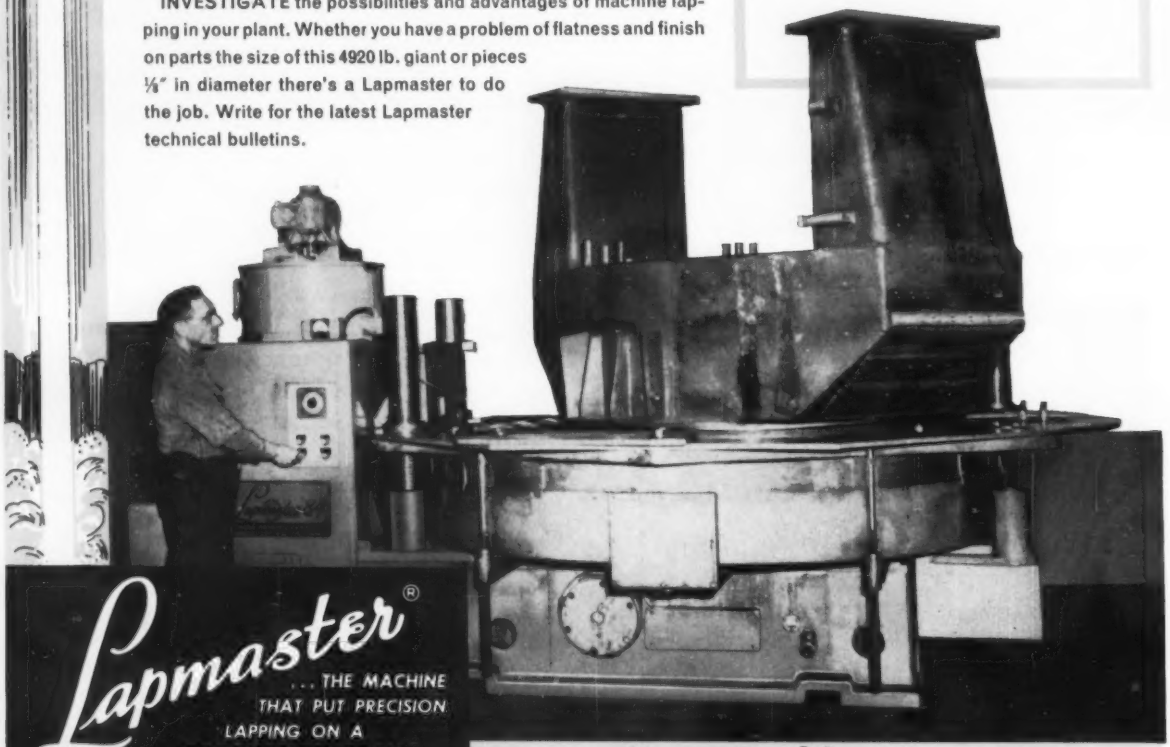
INVESTIGATE the possibilities and advantages of machine lapping in your plant. Whether you have a problem of flatness and finish on parts the size of this 4920 lb. giant or pieces ⅛″ in diameter there's a Lapmaster to do the job. Write for the latest Lapmaster technical bulletins.

JOB DATA

THE PARTS: Several component parts of a tracking antenna for a long-range radar system. Largest was weldment weighing 4,920 lbs. and measuring 84″ in diameter with bearing lands of 48″ O.D. x 46″ I.D. and 14″ O.D. x 12″ I.D. (see photo).

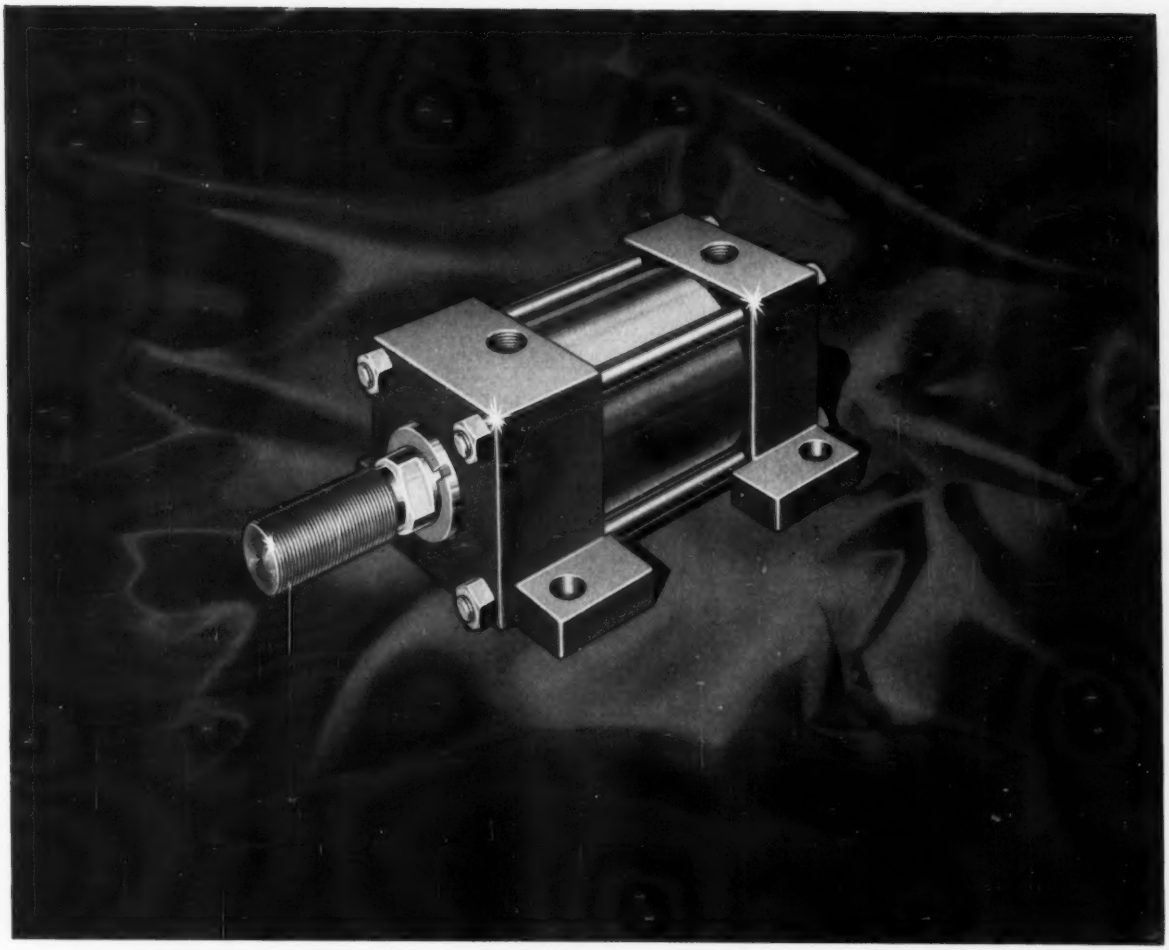
THE SPECIFICATIONS: Flatness and parallelity had to be held to ±.00005″ with bearing lands lapped on the same plane. Faces on mating part are also being lapped to the same specifications.

THE MACHINE: Standard Lapmaster Model 84 equipped with an 85″ O.D. x 10″ I.D. lap plate. Special roller bar with simple mountings and fixtures to control position of the odd shaped parts during lapping.



Lapmaster® . . . THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS . . .

A product of **Crane Packing Company**
6433 OAKTON STREET, Morton Grove, Ill. (Chicago Suburb)
In Canada: Crane Packing Company, Ltd., Hamilton, Ont.



Illustrated—Logan Super-Matic Cylinder Meets J.I.C. Standards

Look to Logan

the ultimate in hydraulic cylinder design

FREE SEND FOR THE "LOGAN CALCULATOR"

MEMBER: Natl. Mach. Tool Builders' Assn.; Natl. Fluid Power Assn.

LOGANSPORT MACHINE CO., INC.
810 CENTER AVENUE, LOGANSPORT, INDIANA

PLEASE SEND COPY OF CATALOG:

- ☐ 100-1 AIR CYLINDERS
- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-5-1 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
- ☐ FACTS OF LIFE
- ☐ 200-1 HYD. POWER UNITS
- ☐ 200-2 ROTOCAST HYD. CYLINDERS
- ☐ 200-3 750 SERIES HYD. CYLINDERS
- ☐ 200-4 and 200-7 HYD. VALVES
- ☐ 200-6 SUPER-MATIC CYLS.
- ☐ 300-1 CHUCKS
- ☐ ABC BOOKLET
- ☐ CIRCUIT RIDER

TO:

NAME_____ TITLE_____

COMPANY _____

ADDRESS _____

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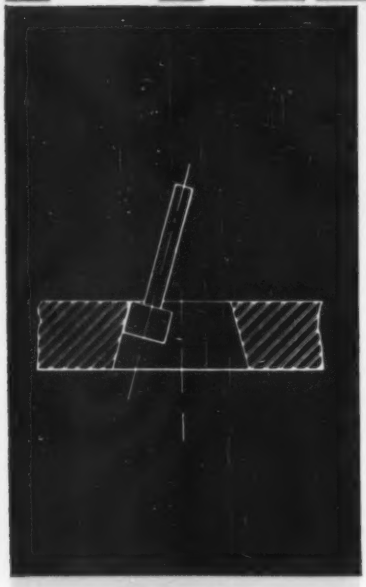
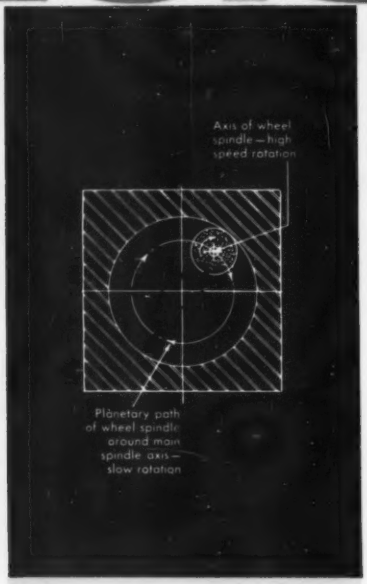
PRECISION



TAPER
(and straight)



PLANETARY

OUTFEED wheel to grind hole; INFEED to grind O. D. of post
Axis of wheel spindle—high speed rotation
Planetary path of wheel spindle around main spindle axis—slow hand rotation

CONTOUR
(with head)

MOORE-FOSDICK JIG GRINDER

A new degree of speed, convenience and capacity is brought to precision grinding in the Moore-Fosdick Jig Grinders. This combination of the unique Moore Grinding Head with Fosdick Jig Borer Tables makes possible advantages never before available.

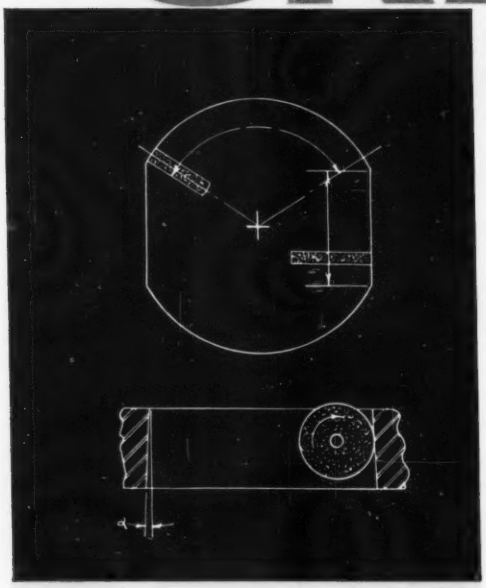
All standard jig grinding operations can speedily and conveniently be accomplished on the Moore-Fosdick, in addition to many which were formerly known as "trick" operations. Both straight and tapered holes can be located and ground, as well as contours consisting of radii and tangents or chordal surfaces.

The angular and indexing device built into the main spindle and the slot grinding attachment permit quick, accurate grinding of any contour, regular or irregular. Setting work on a rotary table is unnecessary except for angular surfaces. Chop grinding removes stock rapidly and makes contour grinding even faster.

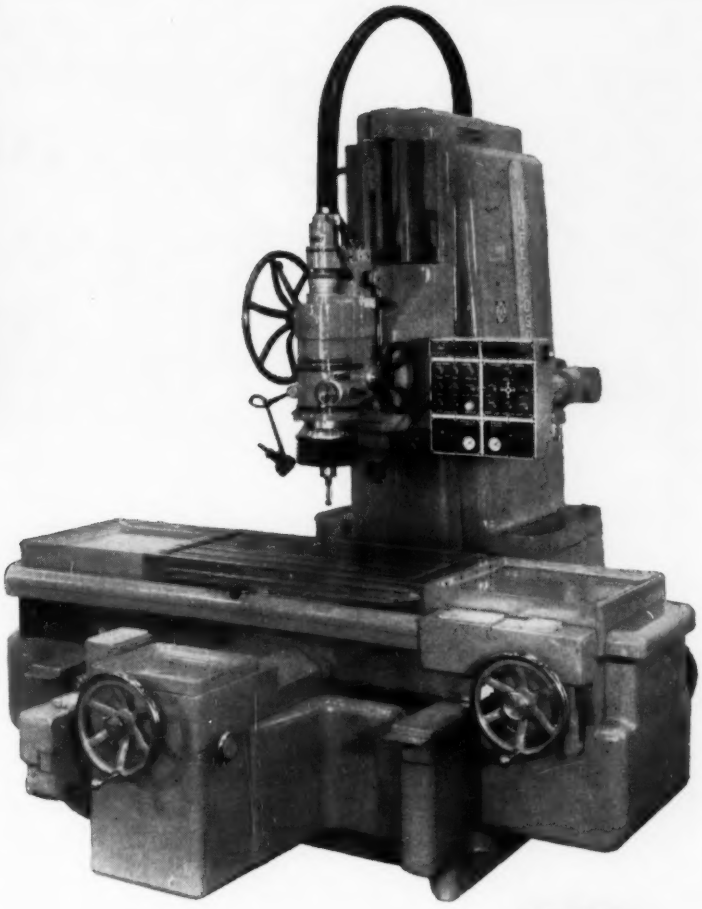
An infinite range of grinding speeds—from 12,000 to 60,000 rpm—allows accurate control

GRINDING

OF LARGE WORK



CONTOUR
(with slot grinder)



of grinding and stock removal. Long-lasting precision is assured by quality construction and by many features that provide dimensional stability, including spindle-housing heat control.

The machine may be ordered in any one of three models, one of which comes in two sizes. *All will give accuracy of ± .0001".*

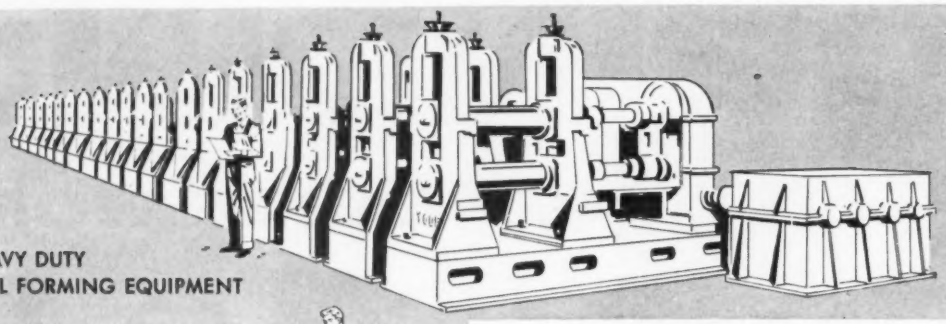
Measuring is accomplished with measuring rods and inside micrometers or with Direct Dimension Measuring, where dimensions are simply set from blueprint to direct reading drum dials. Automatic positioning is also available.

Numerical control by punched tape or cards is available.

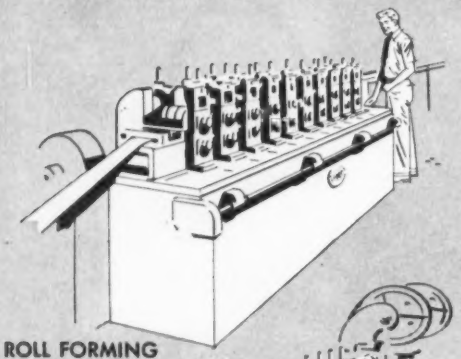
For a complete description of the various grinding operations, measuring systems and other machine features—many exclusive with Moore-Fosdick, write today for your jig grinder catalog.

Ask for Bulletin JG-M.

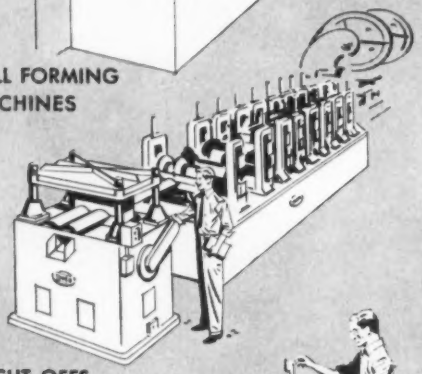
For more data, circle this page number on inquiry card



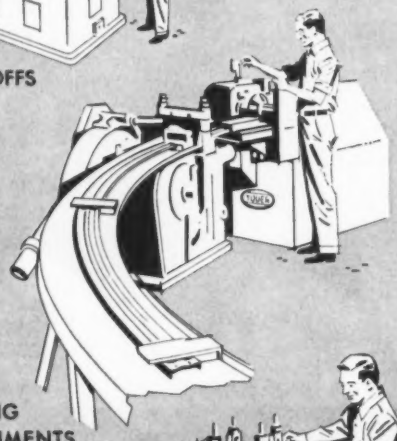
HEAVY DUTY
ROLL FORMING EQUIPMENT



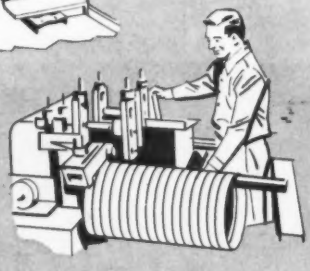
ROLL FORMING
MACHINES



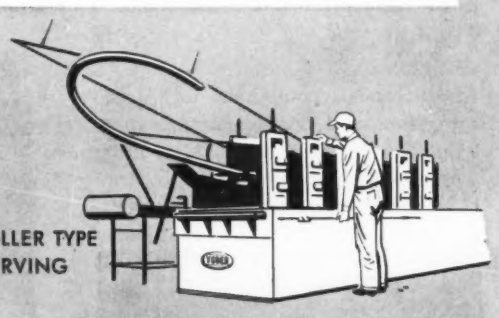
CUT-OFFS



CURVING
ATTACHMENTS



COILING
EQUIPMENT



ROLLER TYPE
CURVING

YODER
COLD ROLL-FORMING EQUIPMENT

for profitable mass production

High speed, YODER Cold Roll-Forming machines are the most economical method for mass producing structural or ornamental shapes. One machine with one operator can form up to 40,000 feet of shapes per day. Even on a part-time basis, a YODER Cold Roll-Forming machine can prove to be a profitable investment.

YODER flexibility works for you too, curving, coiling, ring forming, multiple roll-forming and embossing—on a wide variety of metals—can be incorporated into your production line. Practical, YODER-engineered design minimizes maintenance and downtime... assures uniformity, accuracy and reliability of your end product.

In addition to Roll-Forming machinery, YODER also makes a full line of Rotary Slitting equipment, Pipe and Tube mills. Send for the fully descriptive Cold Roll-Forming Book.

THE YODER COMPANY

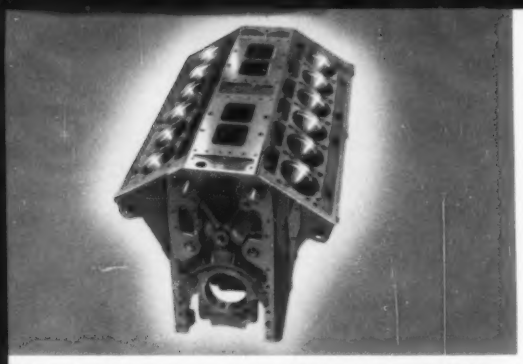
5504 Walworth Ave. • Cleveland 2, Ohio

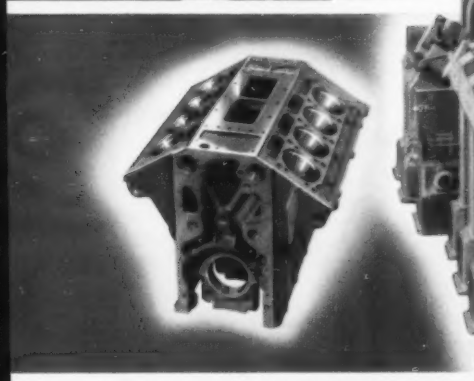
ENGINEERING
YODER
MANUFACTURING

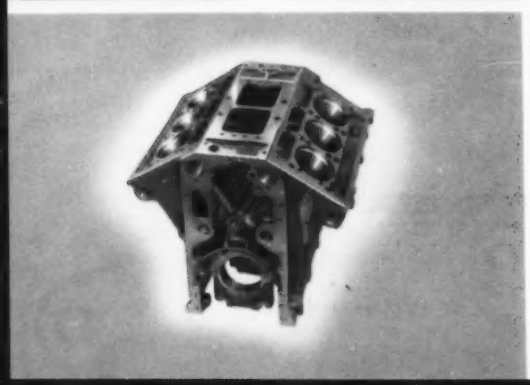
COLD ROLL FORMING MACHINES

PIPE AND TUBE MILLS (ferrous or non-ferrous)

ROTARY SLITTING LINES





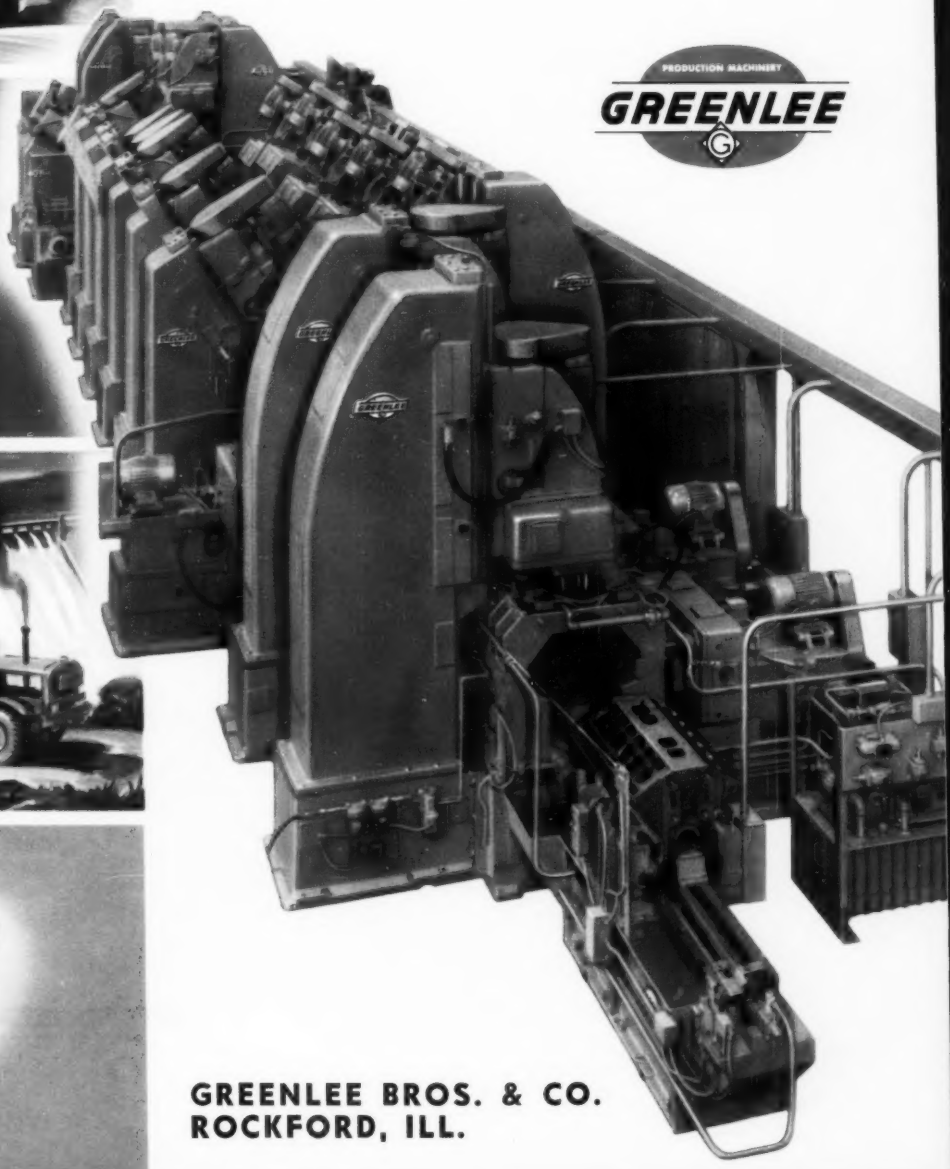


V-type Diesel engine blocks in three different sizes now processed on the same

GREENLEE TRANSFER MACHINES

PRODUCTION MACHINERY

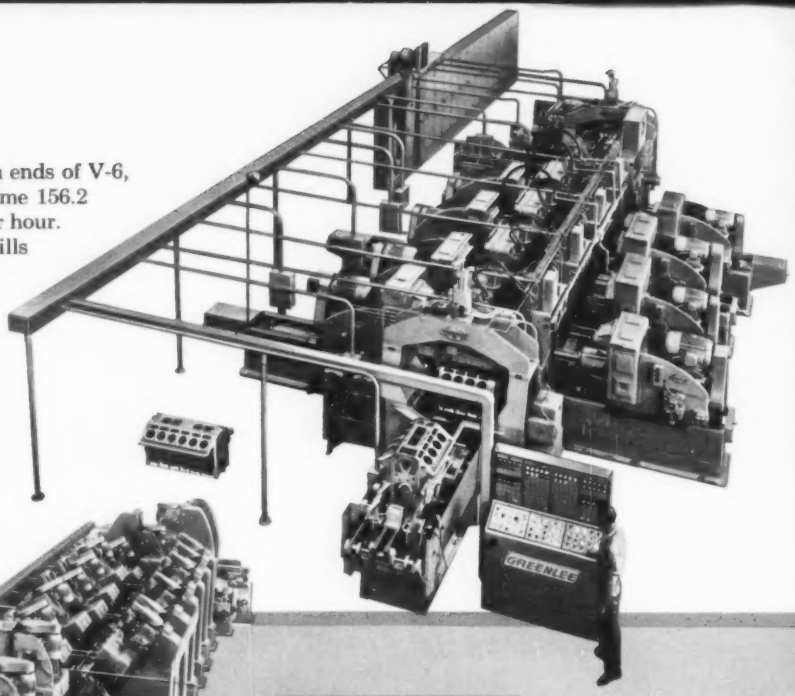
GREENLEE

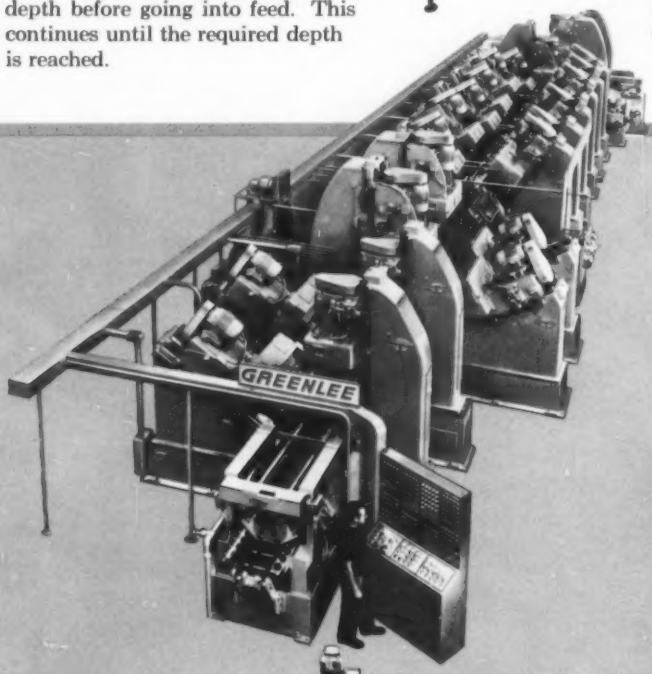


GREENLEE BROS. & CO.
ROCKFORD, ILL.

MACHINE NO. 1

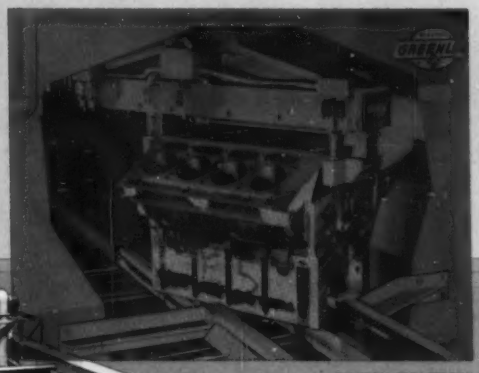
9 stations. 42 feet long. Machines both ends of V-6, V-8 and V-12 cylinder blocks. Cycle time 156.2 seconds. Gross production 23 pieces per hour. Rough bores cam and crank holes. Drills 3 oil galley holes 11 to 18 inches deep. Drills holes for tapping operations. Block is turned 90° in the second station. Heads for deep hole drilling have step feed (jumping jack) action, that is, the drills are fed to a certain depth and then retracted to remove chips. Successive passes rapid-approach to the last drilled depth before going into feed. This continues until the required depth is reached.





MACHINE NO. 2

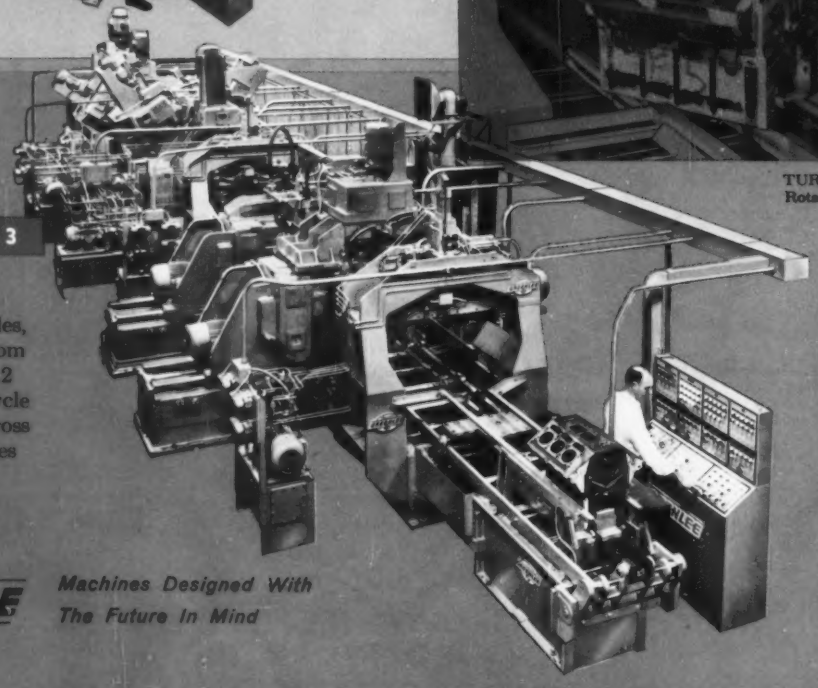
16 stations. 104 feet long. Machines top, bottom, sides and banks of V-6, V-8 and V-12 cylinder blocks. Cycle time 144 seconds. Gross production 25 pieces per hour.



TURN STATION
Rotates Block 90°

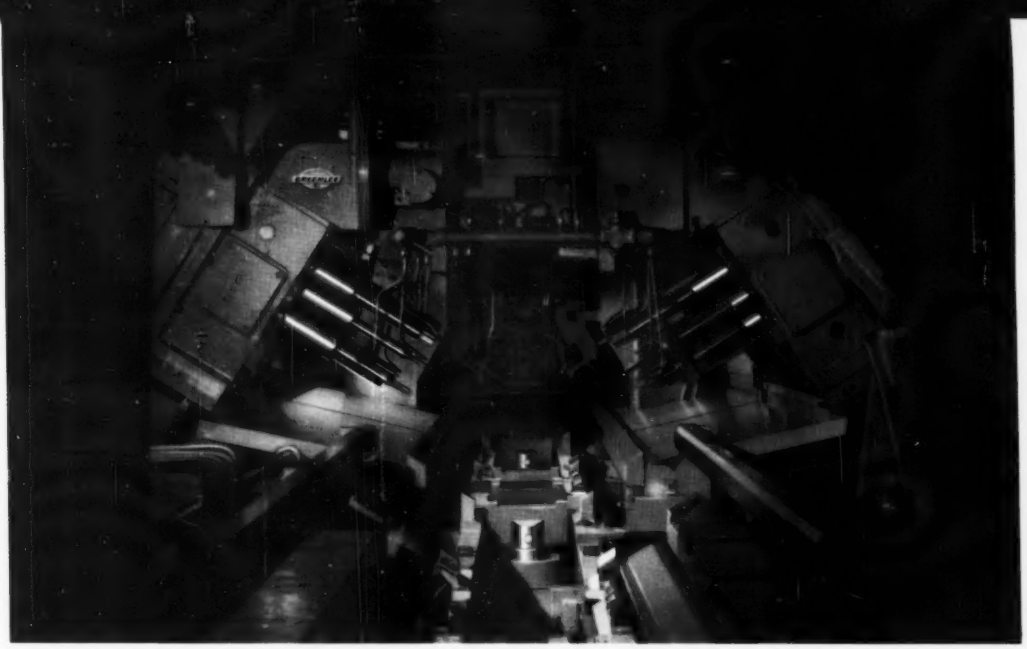
MACHINE NO. 3

11 stations. 64 feet long. Taps ends, sides, banks, top and bottom of V-6, V-8 and V-12 cylinder blocks. Cycle time 35 seconds. Gross production 104 pieces per hour.



GREENLEE

Machines Designed With The Future In Mind



Planned for quick, easy changeovers

A leading manufacturer of diesel engines now includes V-type models in its newly expanded line. In the early stages of planning for production, Greenlee representatives were called in. The problem was not a simple one. Although production rates would not be high — all three cylinder blocks for V-6, V-8 and V-12 engines would have to be processed on the same machines. Changeover time from processing one size block to another must be held to a minimum.

COOPERATION IN DESIGN

To help attain the necessary flexibility, the customer's engineers did an exceptionally good job of designing the blocks for interchangeable processing. Each cylinder, for example, has its own pattern of holes and bearings to permit easy changeover. Components were standardized wherever possible. Greenlee engineers working in close cooperation were able to take full advantage of this flexibility in design to provide further flexibility in machining. Lower initial cost and greater production economies resulted.

MACHINE CHANGES SIZE

When processing the ends of blocks in each of three sizes, the fixture frame and machining heads must be moved to accommodate increased or decreased length of block. A lever pulls the locating pin at each station. When all pins are pulled a push button is pressed and the adjustable part of the machine, together with the transfer bar on that side, moves to its new position. Locating pins accurately position the fixture side frame in its new location.

DOWEL SELECTION

The selection of the proper locating dowel in each station for each size block is controlled by a series of levers. The machines are automatically controlled to operate only when all the levers are set for the same size block.

TOOL CHARTS

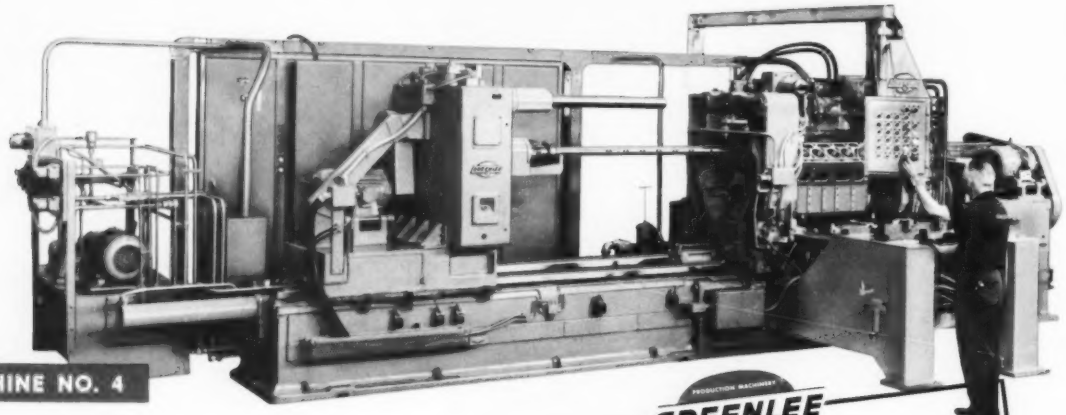
The correct tools and set-up for each size block are readily determined by following the tool charts and changeover check lists supplied with the machines. These charts help reduce changeover time and minimize the possibility of error.

FLEXIBILITY OF OPERATION

These machines were designed to process both cast iron and aluminum blocks. The ease with which they can be changed over from cast iron to aluminum machining demonstrates their extreme flexibility. Variable feed rates and ease of tool change make it possible to change from machining cast iron to machining aluminum in a minimum of down time.

HANDLING

A walking-beam type transfer mechanism is used to carry the blocks from station to station. The blocks are *carried*, not *skidded* through all five machines. Machine No. 1 has two turn stations, rotating 90°. Machine No. 2 has one 180° turnover station. Machine No. 3 has two turn stations rotating 90°, and one 180° turnover station. These 90° rotating stations are designed to handle the three different sizes of blocks without adjustment. The 180° turnover stations are manually adjusted in seconds to accommodate any of the three block sizes.



MACHINE NO. 4

Two-way horizontal machine automatically semi-finish bores cam holes, and finish cross-faces rear thrust bearing. Cycle time 103 seconds. Gross production 35 pieces per hour.

The sequence of operations automatically performed on this machine is as follows:

(1) Block is conveyed to machining position.

(2) Block is positioned to receive boring bar.

(3) Boring bar is advanced.

(4) Block is located for the boring cut.

(5) Boring bar is rotated and fed on the return stroke. This results in a pulling action keeping the bar in tension and eliminating vibration.

(6) After boring operation is completed, bar is positioned radially, block is positioned and bar is withdrawn.

(7) Block is removed from machine.

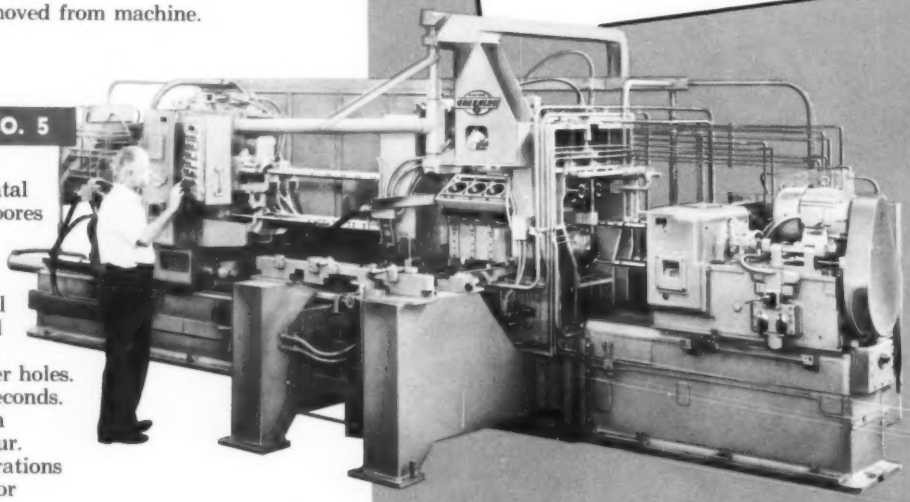
GREENLEE

FACILITIES and EXPERIENCE

(1) Greenlee plant facilities are large enough to erect a complete line and conduct test runs with coolant supplied from a central system built into the assembly floor.

(2) Greenlee controls every step in the manufacture of the machines which it produces. Engineering, foundries, machine shops, assembly floors are all centralized in Rockford.

(3) Greenlee has the experience and proven ability to build successful transfer machines . . . is considered one of the pioneers in the field of mechanized production.



MACHINE NO. 5

Two-way horizontal machine finish bores cam holes. Finish bores crank bore. Reams two dowel holes in each end of block. Finish counterbores idler holes. Cycle time 131 seconds. Gross production 27 pieces per hour. Sequence of operations is the same as for Machine No. 4.

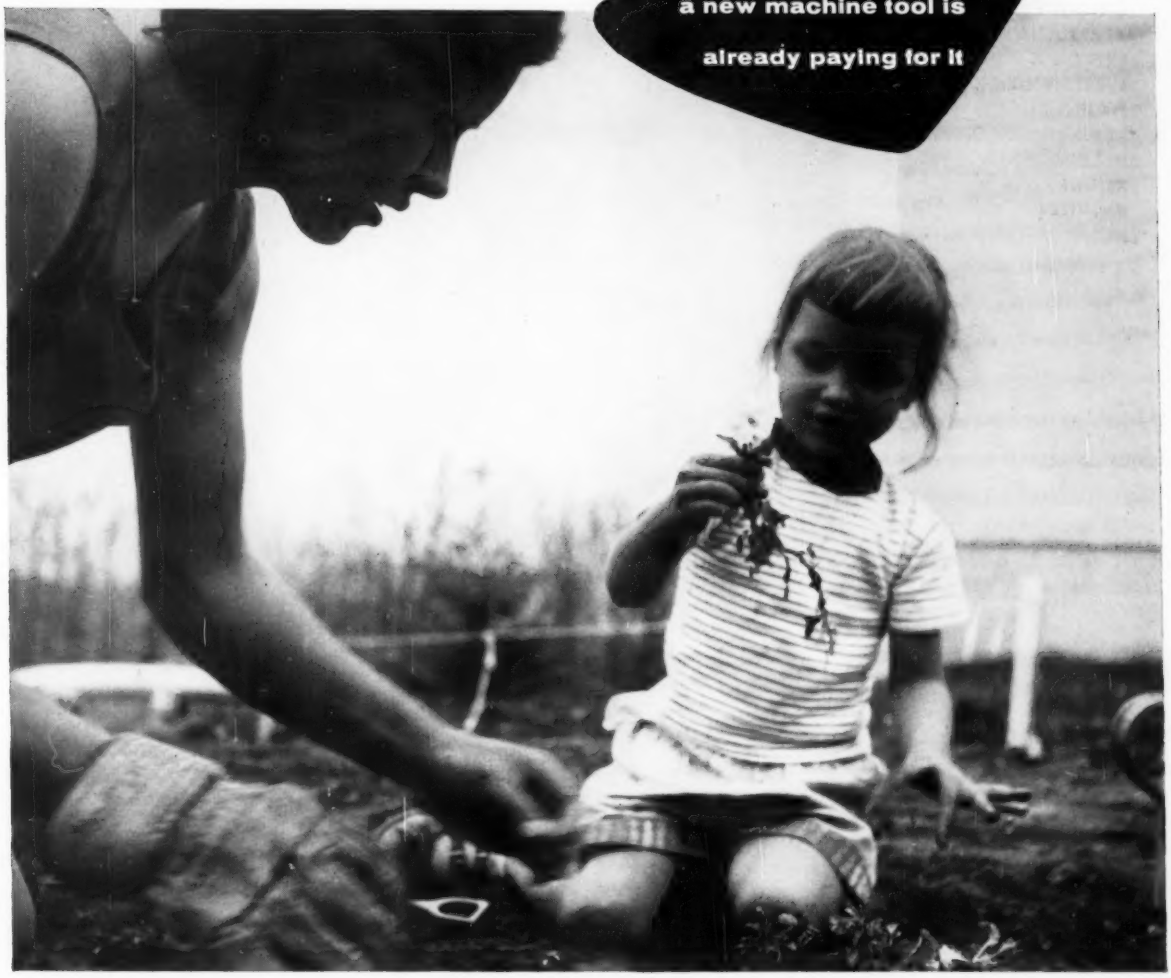
GREENLEE
BROS. & CO.

1811 MASON AVE.
ROCKFORD, ILLINOIS

Printed In U.S.A.

JONES & LAMSON MACHINE COMPANY

the man who needs a new machine tool is already paying for it



Spring planting...1949

Just ten short years ago, but a lot of changes have taken place.

Except for Mother, who is every bit as attractive, nothing has remained the same. The garden is now long-established and flourishing, and Daughter is entering college in the fall.

In Dad's shop, things are quite different, too. Labor rates, prices of raw materials and overhead have kept climbing constantly.

Those once-new machines are still running O.K., and seem to have plenty of usefulness left in them. The big hitch, though, is that their performance standards were based on the costs of *ten years ago*. With today's increased costs, the *profitability* of these machines is in serious doubt.

The cost analyses Dad is now completing show very clearly that successful production under *today's* conditions requires *modern* equipment. He used J & L's new "Avoidable Costs" Replacement Formula. It's simple, clear cut and realistic, and avoids the fallacies found in other replacement formulas.

Write for your copy.

Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

AIRCO INDUSTRIAL AND RARE GASES

ARGON
OXYGEN
ACETYLENE
NITROGEN
NITROUS OXIDE
HYDROGEN
CARBON DIOXIDE
HELIUM
XENON
KRYPTON
NEON

Saturated nitrogen vapor test chamber, custom-designed and built by Stewart-Warner, working with Air Reduction's Technical Service Organization. When readied by the technician, chamber was sealed. *Cold* nitrogen vapor then was introduced and used at approximately −300°F.

AIRCO INDUSTRIAL GASES... PART OF THE PICTURE IN CRYOGENICS ENGINEERING

at Stewart-Warner

Here's how South Wind Division of Stewart-Warner used Air Reduction Nitrogen and Helium in testing liquid oxygen valves

In testing the efficiency of liquid oxygen tank vent valves developed for missiles, Stewart-Warner utilized Air Reduction liquid nitrogen as a "stand-in" for liquid oxygen.

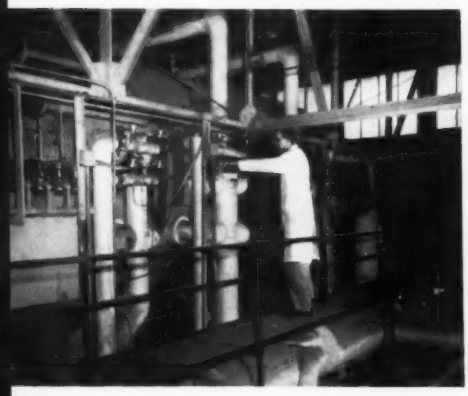
The reasons why were good ones: the data on easy-to-work-with nitrogen could be applied to predict the behavior of oxygen under similar conditions; nitrogen does not combine easily; it is incombustible.

In the vital leakage tests of the valves, Air Reduction helium was employed. Complete tightness of the shutoff mechanism was mandatory, and the high diffusion rate of helium best qualified it to serve in this phase of the testing operation.

In order to assure a steady supply of nitrogen and helium, Air Reduction's Technical Service Organization set up, adjacent to the Stewart-Warner laboratory, both a permanent installation for liquid nitrogen and a helium manifold.

This is but one area of cryogenics where Air Reduction gases—and technical knowledge—are being used extensively. Here, as elsewhere, a principal feature of Airco Industrial Gas Service is absolute dependability of supply.

If you use industrial gases, or think one of them might help improve a process or product in your operation, call in your nearby Airco Engineering Service Representative. Let him show you how your needs can best be met by Air Reduction . . . most experienced supplier of high purity industrial gases.



Refrigeration equipment for further tests. Choice of Airco assures dependable supply of industrial gases for *cryogenic* testing—from the Greek word meaning, "Creation of icy cold."

Test data and control panel. Under such precision controls, Airco gases are advancing frontiers in many industries such as missiles, aircraft, electronics, steel, chemicals, and food processing.

Airco's liquid nitrogen installation at the Stewart-Warner cryogenics lab, in Indianapolis. Helium manifold far right. These facilities make it practical to maintain reserves of both vital gases.

AIRCO®

AIR REDUCTION SALES COMPANY

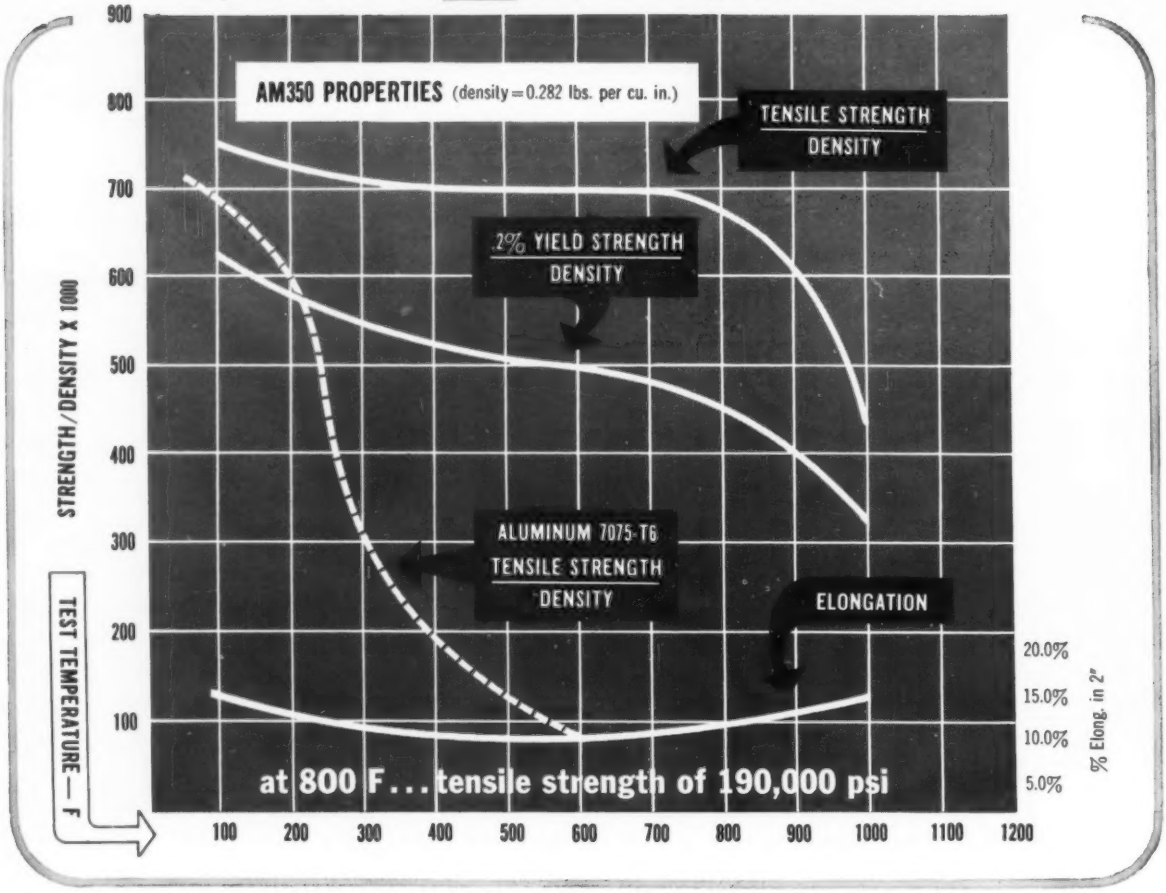
A Division of Air Reduction Company, Incorporated

150 East 42nd Street, New York 17, N. Y.

Offices and dealers in most principal cities • On the west coast—Air Reduction Pacific Company • Internationally—Airco Company International • In Cuba—Cuban Air Products Corporation • In Canada—Air Reduction Canada Limited • All divisions or subsidiaries of Air Reduction Company, Inc.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT • Products of the divisions of Air Reduction Company, Incorporated, include: **AIRCO**—industrial gases, welding and cutting equipment • **AIRCO CHEMICAL**—vinyl acetate monomer, vinyl stearate, methyl butynol, methyl pentynol, and other acetylenic chemicals • **PURECO**—carbon dioxide—gaseous, welding grade CO_2, liquid, solid ("DRY-ICE") • **OHIO**—medical gases and hospital equipment • **NATIONAL CARBIDE**—pipeline acetylene and calcium carbide • **COLTON**—polyvinyl acetate, alcohols, and other synthetic resins.

Experience**—the extra alloy in **Allegheny Stainless



Here are the facts on AM350 and AM355, Allegheny Ludlum's precipitation hardening stainless steels

A unique combination of highly desirable properties is the usual description of Allegheny Stainless AM350 and AM355 Steels. They combine high strength at both room and elevated temperatures, excellent corrosion resistance, ease of fabrication, low temperature heat treatment, good resistance to stress corrosion.

They are proving the answer to many problems of the air age. Airframe and other structural parts, pressure tanks, power plant components, high pressure ducting, etc. are all natural missile and supersonic aircraft applications for AM350 and AM355.

Availability: AM350, introduced several years ago, is available commercially in sheet, strip, foil, small bars and wire. AM355, best suited for heavier sections, is available in forgings, forging billets, plate, bar and wire.

Corrosion resistant: Being stainless steels, these alloys resist corrosion and oxidation. Compared to the older, more familiar stainless grades, their corrosion rating is better than the hardenable grades (chromium martensitic) but generally less than the old corrosion resistant standbys, the 18 and 8's. Stress corrosion is resisted at much higher hardness levels than with martensitic stainless.

Simple heat treatment: High strength is developed by two methods, both involving less than ordinary temperatures and minimizing oxidation and distortion problems. The most popular, and one that develops slightly better properties, is the Allegheny Ludlum developed sub-zero cooling and tempering (SCT condition). The material is held at minus 100 F for 3 hrs plus 3 hrs at 850 F. Alternate method is Double Aged (DA): 2 hrs at 1375 F plus 2 hrs at 850 F.

Easy fabrication: AM350 and AM355 can be spun, drawn, formed, machined and welded using similar procedures as with the 18-8 stainless types. In the hardened condition (SCT & DA) some forming may be done . . . 180 degree bend over a 3T radius pin. Also it can be dimpled in the hard condition to insure accurate fit-up.

For further information, see your A-L sales engineer or write for the booklet "Engineering Properties, AM350 and AM355." ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*** Address Dept. M-19.

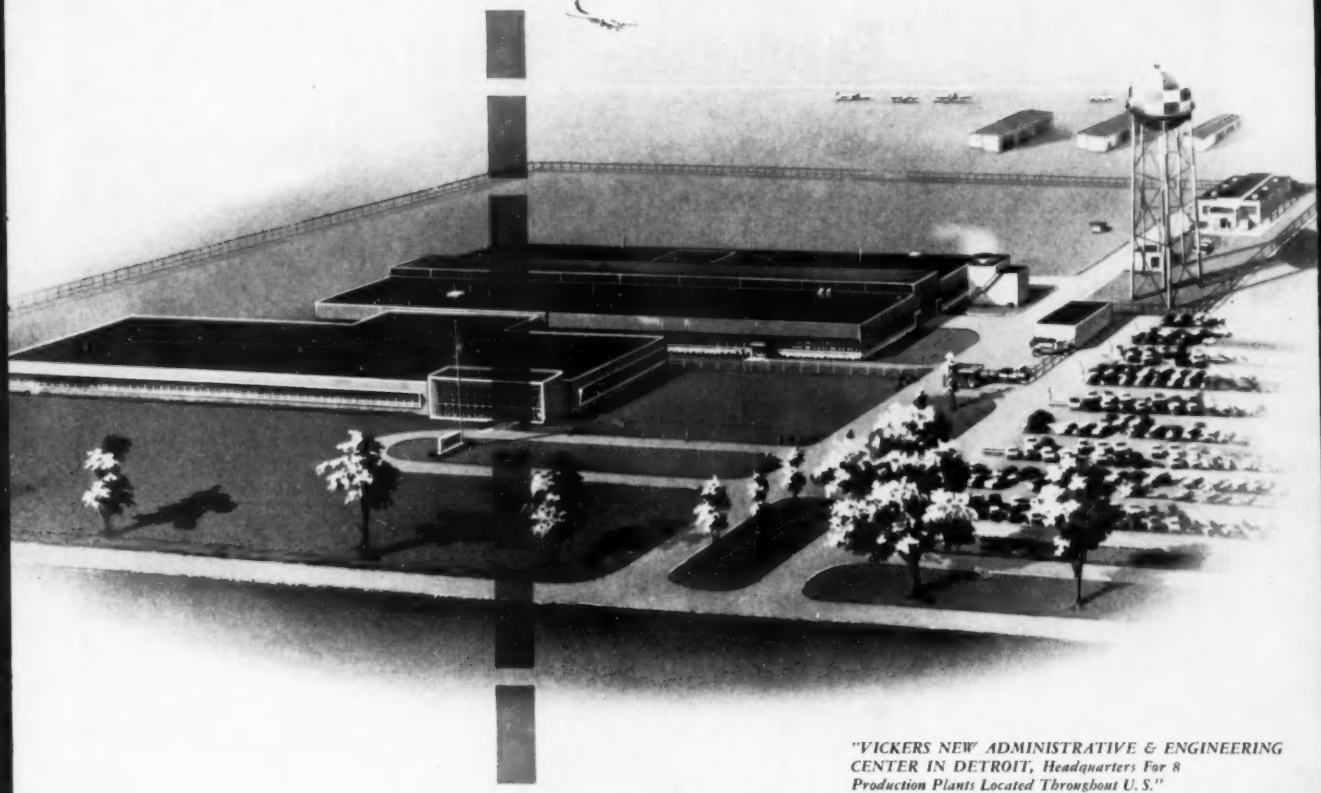
WSW 7327

ALLEGHENY LUDLUM

Export distribution: AIRCO INTERNATIONAL

EVERY FORM OF STAINLESS . . . EVERY HELP IN USING IT

Cost reduction programs



"VICKERS NEW ADMINISTRATIVE & ENGINEERING CENTER IN DETROIT, Headquarters For 8 Production Plants Located Throughout U. S."

by **W. K. ALLEN, *Vice President, Production***
VICKERS INCORPORATED

"WE PREFER to think in terms of "Cost Improvement" and "Product Improvement" rather than "Equipment Replacement Programs."

"While it is true that in carrying out "Cost Improvement" and "Product Improvement" Programs, the end result quite often involves replacement of Equipment; we believe the former channels our thinking along more objective lines. When you think in terms of just "Equipment Replacement," it has the connnotation of replacing obsolete or deteriorated machinery by use of a formula. The big savings is not in a continuous replacement program for obsolete machines but providing the proper equipment to produce the best quality at the lowest cost with the greatest return on investment."

July, 1959

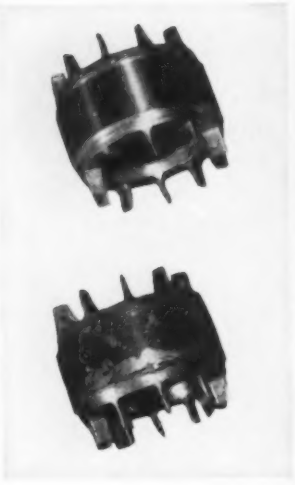
Rockford Insert Group

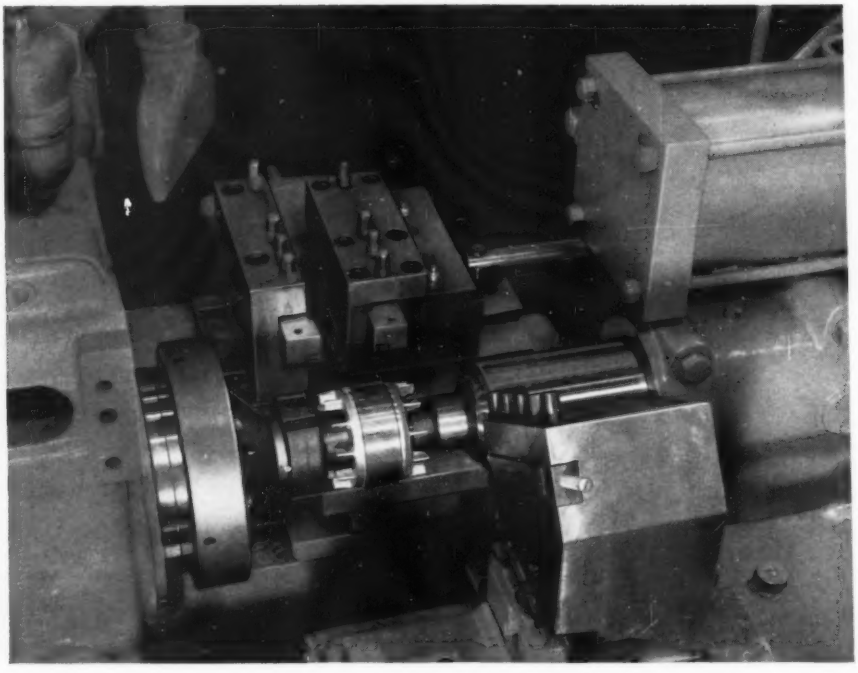
Keep gathering metalworking production ideas . . . be well informed when you replace machinery . . .

SUNDSTRAND

"ENGINEERED PRODUCTION" NEWS

Stators of varied lengths turned on self-compensating lathe





Finished stator at top shows turning and chamfering operations performed on machine equipped with power tailstock that automatically compensates for length of part. Rough and finish tools in front holder and chamfering tools in rear holder permit doing the job in a single cycle.

Single cycle turning — including rough and finish turning of the OD and chamfering of both ends of the stator — is handled on this Sundstrand lathe provided with automatic compensation for varied part lengths. The stator cores vary in length from ¾ to 3 inches and production ranges from 115 to 154 per hour.

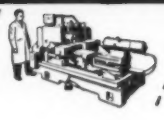
This job is a good example of how a modern machine of standard design — the Sundstrand Model 8 in this instance — can be adapted to the requirements of a specific job through the application of Sundstrand "Engineered Production." Even though the basic machine is standard, thus holding down capital investment, special tooling and a special powered tailstock automatically position the front and rear tools for the length of part being machined. This provides "custom" features for maximum production at minimum cost.

Sundstrand lathes are basically designed to use standard components to the greatest possible extent. Then, after the job requirements are studied by Sundstrand machine designers, tooling and manufacturing engineers, recommendations are made. Even when production requirements or configuration of the part is such that a "special machine" is needed, basically standard components still constitute a large part of the total machine.

Because Sundstrand designs, builds, and is experienced in the operation of every type of turning equipment, this combination of factors helps assure ultimate customer satisfaction both in price and performance.

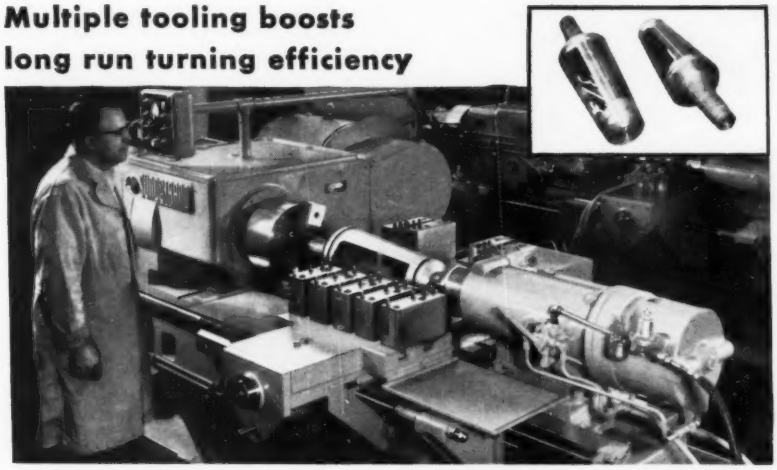
AUTOMATIC LATHES | MILLING MACHINES | SPECIAL MACHINES | DRILLING MACHINES | GRINDERS

SUNDSTRAND



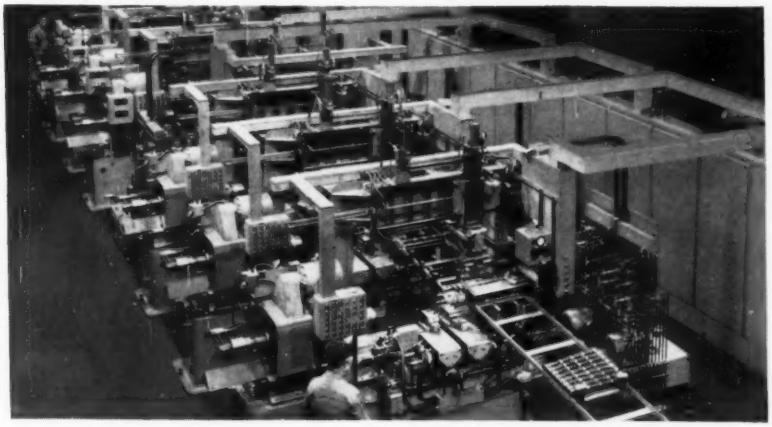
CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

Multiple tooling boosts long run turning efficiency



Long runs requiring the machining of several surfaces on a single part provide an outstanding opportunity for cost reduction by combining operations through efficient tooling. This job being produced on a Sundstrand Model 12A lathe uses 5 front tools to turn the OD and 4 rear tools for grooving and chamfering various valve plugs.

Production ranges from 9 to 35 parts per hour depending on the size of the valve component. Part shown in the inset is one of the larger sizes being produced, measuring 9¼ in. diameter and 18 in. long. Fast setting of machine cycle control and accessibility of tooling make changeover for other sizes a quick and simple operation, holding down-time to a minimum.

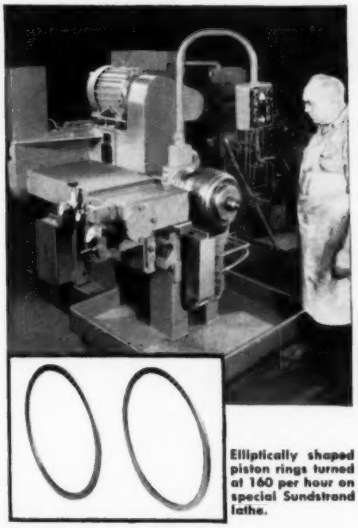


Special automatic loading process lathe by Sundstrand produces over 200 camshafts per hour at 80% efficiency, yet carries out the basic Sundstrand idea of maximum utilization of standard components. Obviously, the automatic handling equipment plus the automatic transfer, loading, and unloading of workpieces makes this a custom designed installation; yet a Sundstrand "Engineered Production" analysis prior to start of actual design determined that a number of standard components were ideally suited to the operations required.

Eight lathes in two lines use carbide tools for roughing and cemented oxide tools for finish turning. Because workpieces are supported as close as possible to surfaces being machined, exceptionally fine surface finishes are produced.

Eliptical shapes produced on special machine

When it comes to special turning jobs — those that can't be handled by conventional machines due to their configuration or any other reason — Sundstrand designs and builds special machines to meet these requirements.



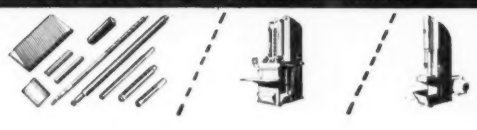
Elliptically shaped piston rings turned at 160 per hour on special Sundstrand lathe.

This lathe for elliptical turning of the OD of piston rings provides a good example of how Sundstrand handles the special jobs economically. A special eccentric front slide, cam actuated with a power take off from the rear of spindle, is used for elliptical turning of piston rings ranging in size from 8 to 21½ inches. Production rate averages 160 rings per hour.

Sundstrand has designed and built numerous specially designed lathes for every conceivable type of turning job. The experience gained in solving these problems is your assurance of getting top results on your job.

For more data on how Sundstrand "Engineered Production" is applied to small lot, long run, and special turning jobs, write for Bulletin 605 today.

BROACHING TOOLS BROACHING MACHINES PRESSES



SUNDSTRAND MACHINE TOOL
Div. of SUNDSTRAND CORPORATION
Belvidere, Illinois • U. S. A.

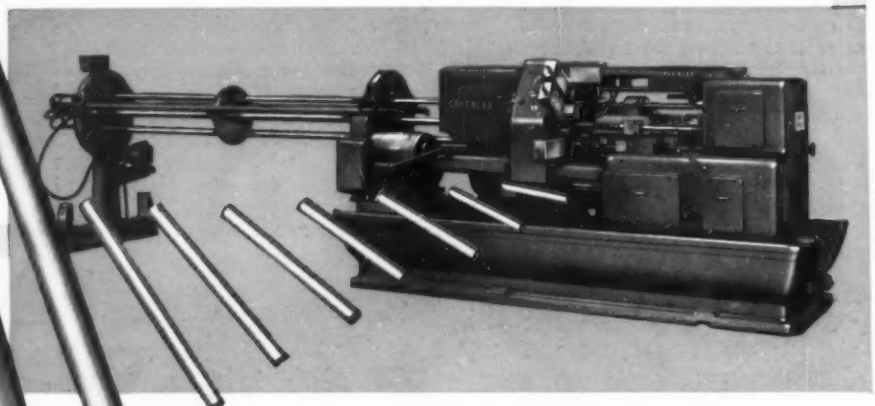
CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

PRODUCTION MACHINERY

GREENLEE

AIR-FEED AUTOMATICS

Eliminate Stock Pushers...
Eliminate Scoring of Stock...
Provide For Extra Length Feed-Out...
Reduce Downtime During Set-Up



MULTIPLE FEED-OUT

Permits Greater Job Versatility and Added Profits

Greenlee Standard and Special Machine Tools

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines
- Die Casting Machines

Greenlee Air-Feed Automatics give you a competitive edge. The multiple feed-out arrangement offers a distinct profit advantage in machining many types of parts. Threads and oil grooves may be rolled on any portion of long shafts. Finish forming may be done on either end. See your Greenlee Distributor. He'll show you how Greenlee Air-Feed Automatics will pay off for you.

Write today for Catalog A-405 — first step on the way to more profitable production with Greenlee Automatic Bar Machines.

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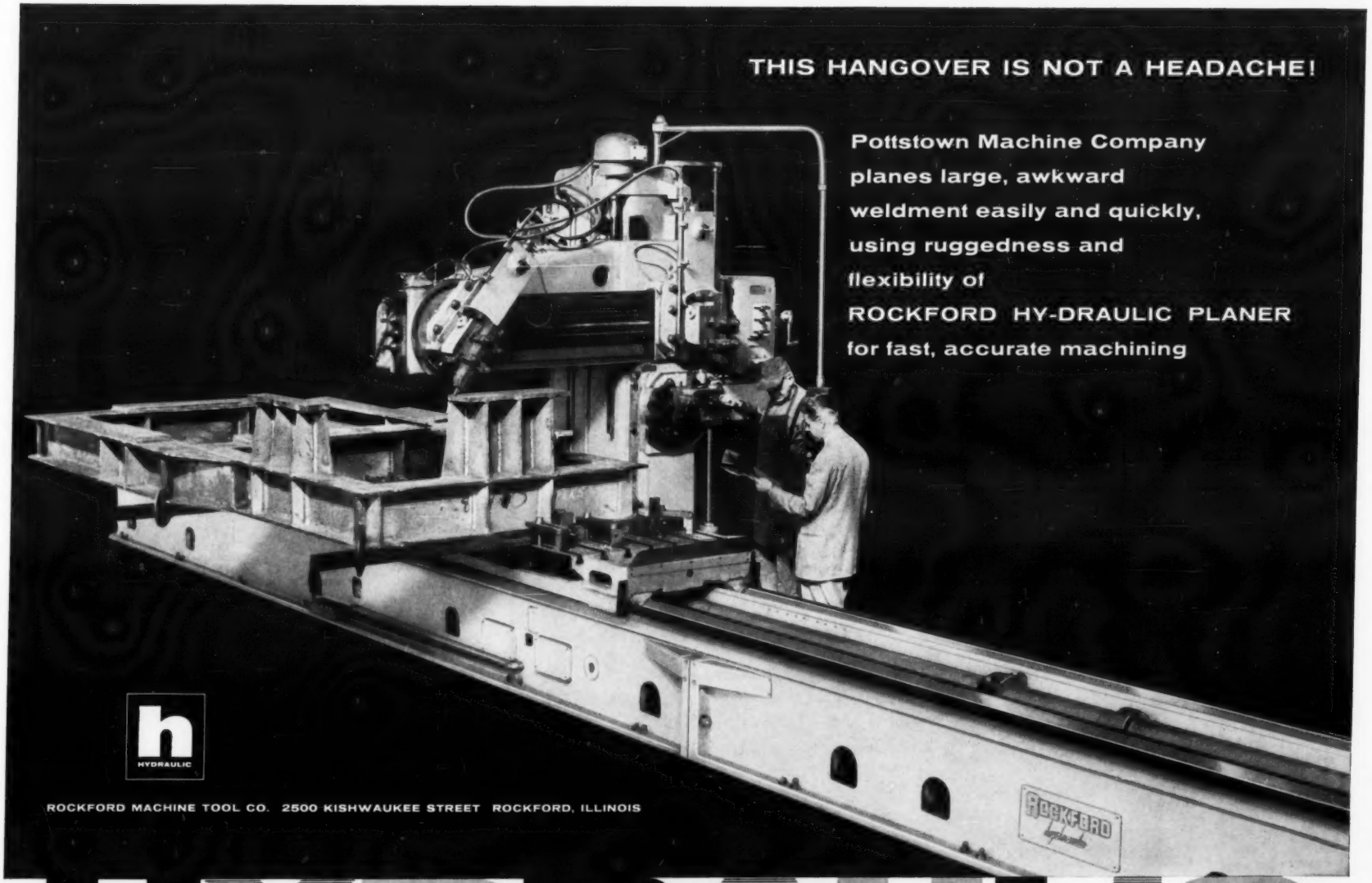
CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**



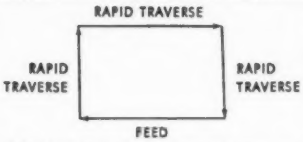
HY-DRAULIC

CITY OF MACHINE-TOOL SPECIALISTS ROCKFORD, ILLINOIS, U.S.A.

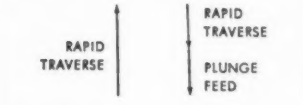
How to increase productivity with...

Multicycle Hobbing

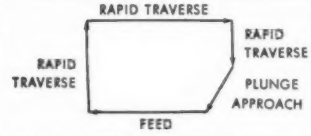
Any one of these automatic cycles can be selected simply by turning a switch on the control panel.



SQUARE CYCLE – automatic version of the conventional hobbing cycle.



PLUNGE CYCLE – automatic vertical feed for cutting worm gears.



PLUNGE-APPROACH CYCLE – combination of "plunge" and "square."

Automatic cycling plus the opportunity to greatly reduce approach time in many cases makes the Multicycle version of the Barber-Colman No. 16-16 Hobbing Machine a high-production machine, and yet it is extremely versatile.

Reduce approach time

The new Multicycle machine offers three different automatic cycles (see sketch). Any of these can be selected simply by turning a switch. With the plunge-approach cycle for cutting helical gears and worms (or when using large, multiple-thread hobs), you can greatly reduce long approach time. With the push of a button, cam vertical feed and conventional horizontal feed cycle automatically. The hob starts cutting at full depth faster. Clamping and unclamping of the workslide is automatic. The operator just loads and unloads the work.

Automatic machines can be versatile, too!

To cut worm gears, turn the selector switch to "plunge," disengage the feed change gears, turn the dial control to proper cam speed, set the vertical stops, and push the start button. The workslide lowers rapidly to the cutting position. The work feeds slowly to full depth as it is being hobbed, and then dwells for the desired number of revolutions. When the hob stops, the workslide returns to starting position.

Is there a Multicycle machine for you?

You bet there is. These same features are available in the No. 6-10 machine. Additional equipment, such as differential gearing, accessory vertical feed cams, and even full automation, will adapt this precision hobbing machine to almost any job. Send us prints of your gears. We'll give you a complete report on the time saved by a Multicycle machine. Call your nearest Barber-Colman field office or the factory, WO 8-6833.

Barber-Colman Company

BARBER COLMAN ®

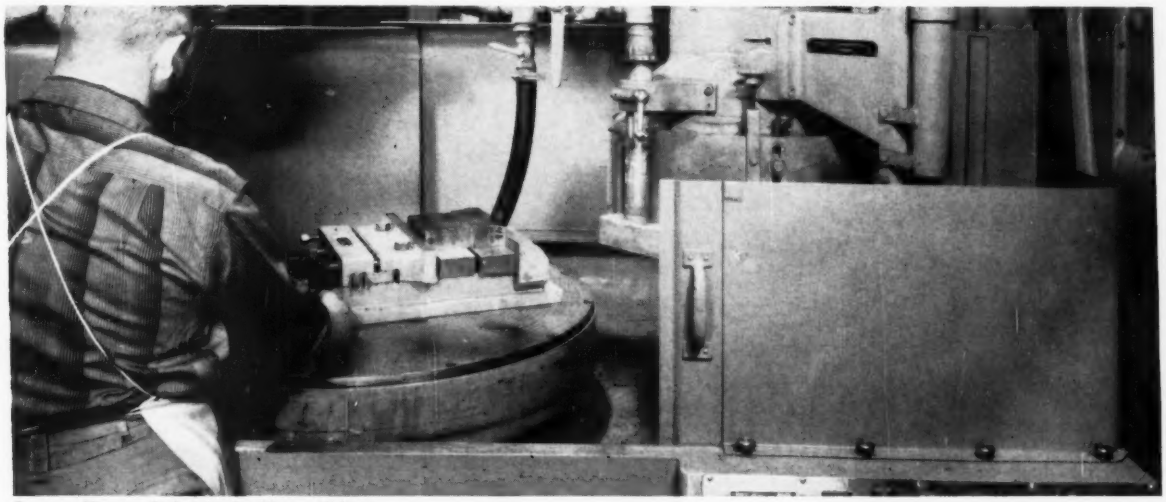
72 Loomis Street, Rockford, Illinois

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

Fast, new grinding method replaces cutter-type machining

Betters production time by 75% . . removes up to ¼ in. stock per side . . . *economically*



Courtesy: Alignment Engineering Co., Warren, Michigan

Fig. 1—No. 24 vertical-spindle rotary pulls up to 60 hp through the spindle. Grinding mild steel, this rugged machine removes metal up to three times faster than conventional surface grinders. With this in mind, many plants (like this one) are buying them as a stock-removal tool.

Three shapers replaced . . . machining time cut from 6 to 1½ hr. . . . up to ¼ in. stock removal per side economical with new method . . .

These are results from a Michigan company (typical jobs shown) after installation of a Mattison No. 24 vertical-spindle surface grinder with Quick-Tilt spindle. Such performance proves that a rigid, high-powered vertical is now . . . more than ever . . . a stock-removal machine as well as a precision grinder.

Two machines for the price of one

Until the introduction of the Quick-Tilt spindle rotary late last year, grinding dead flat parts on a production basis meant you had to accept one of two types of inefficiency: (1) excessive downtime for changing one machine from a rougher to a finisher . . . or (2) "two-timing"—keeping two grinders set up for successive roughing and finishing.

Now, a flick of the switch tilts the spindle for rough and finish operations in a single setup, without even stopping the machine. In effect, this gives you two machines for the price of one. But, that's only part of the story.

The Quick-Tilt rotary does more than provide a dual cycle on one grinder. It combines high horsepower (60 on the No. 24—100 on the No. 36) and rugged construction, with the best features available for precision, fine-finish work.

Fig. 2—Quick-Tilt improves accuracy, too. Parts requiring extremely close tolerances can be ground faster, utilizing full table capacity.

Hidden savings a big factor

Another reason why it pays to own a new Mattison is reduction of hidden costs. You can reduce your stock allowances for grinding and eliminate cutter-type machining of flat surfaces. With self-dressing wheels, machine downtime for changing the cutting tool and cost of re-sharpening can be eliminated. This is important because actual machining time on a surface grinder is often less than on a machine that produces much bigger chips. Improved finish and accuracy are a bonus. And don't forget—hard spots, burned edges, and tough outer scale are no problem for a grinding wheel.

To the grinding man all these advantages add up to *maximum versatility in a standard machine.*

Ask for a test grind

We don't expect you to rush through a purchase order for a new grinder on the strength of this ad. But, if it seems to make sense in terms of your particular machining problems and costs, we do hope you'll investigate further. Send us your piece-parts for a sample grind in the Mattison Methods Lab. There's no cost (other than shipping expense) for a complete report covering stock removal, wheel life, production rate, wheel specs, surface finish, accuracy, etc. Your Mattison dealer will make all the arrangements—or, phone the factory direct.

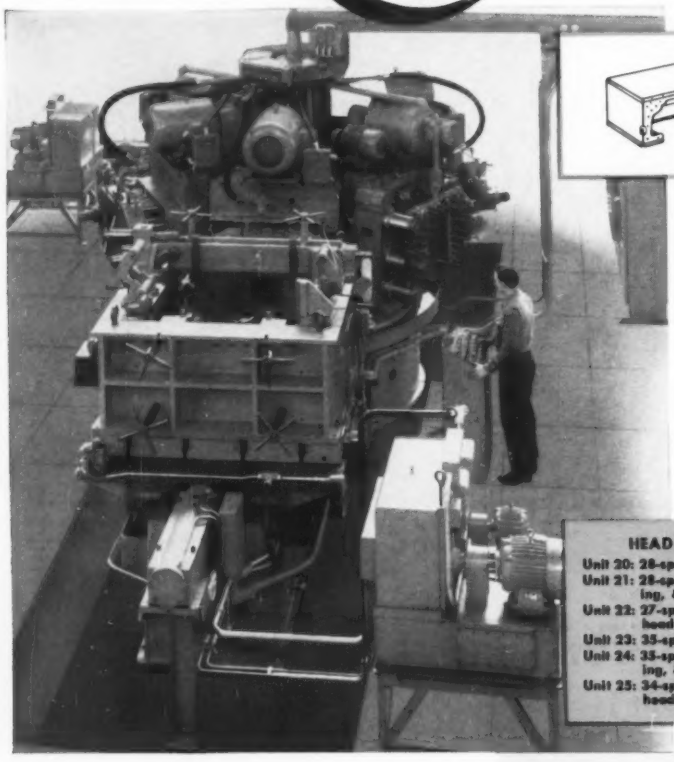
MATTISON MACHINE WORKS
Rockford, Illinois • WOodland 2-5521

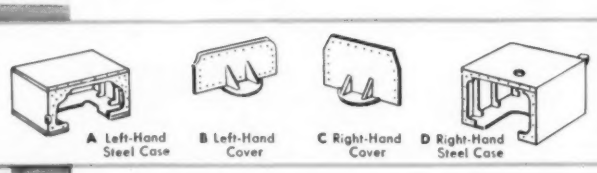
MATTISON MACHINE WORKS
HIGH-POWERED PRECISION SURFACE GRINDERS

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

NEW W. F. & JOHN BARNES STANDARD Versa-Matics

Patents Pending





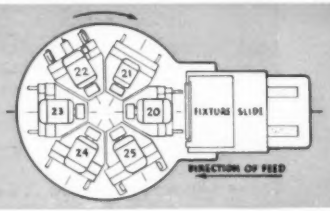
MACHINE No. 1

Standard Barnes "Versa-Matic" with 6-Station Rotary Table and Shuttle-Type Work Holding Fixture. Drills, reams, chamfers, and taps workpieces A, B, C, D, and E.

Approx. Loading Time per piece ..... 3.00 min.
Approx. Unloading Time per piece ..... 2.00 min.
Gross Production (100% efficiency):
Case Parts ..... 6.55 per hr.
Cover Parts ..... 9.50 per hr.

HEAD OPERATIONS

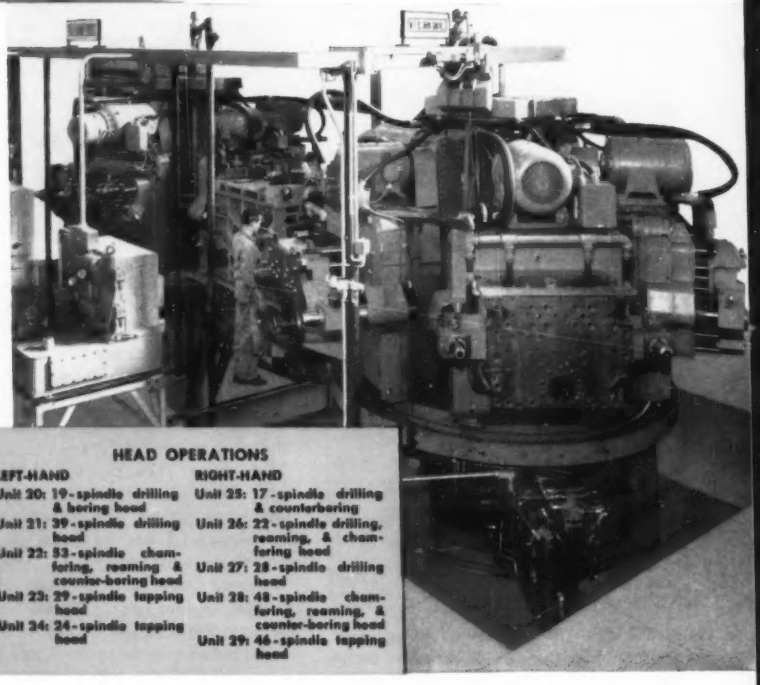
Unit 20: 28-spindle drilling head
Unit 21: 28-spindle chamfering, reaming, & counterboring head.
Unit 22: 27-spindle tapping & milling head
Unit 23: 35-spindle drilling head
Unit 24: 33-spindle chamfering, reaming, & counterboring head
Unit 25: 34-spindle tapping & reaming head

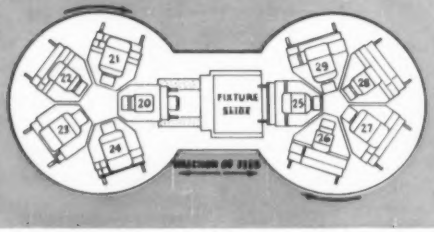


MACHINE No. 2

Standard Barnes "Versa-Matic" with Two Five-Station Rotary Tables and Shuttle-Type Work Holding Fixture. Drills, chamfers, reams, and counterbores different surfaces of same workpieces A, D, and E processed on Machine No. 1.

Approx. Loading Time per piece ..... 3.00 min.
Approx. Unloading Time per piece ..... 2.00 min.
Gross Production (100% efficiency) ..... 2.90 per hr.





HEAD OPERATIONS

LEFT-HAND

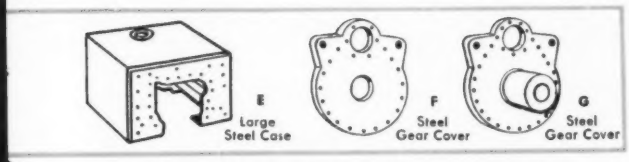
Unit 20: 19-spindle drilling & boring head
Unit 21: 39-spindle drilling head
Unit 22: 33-spindle chamfering, reaming & counter-boring head
Unit 23: 29-spindle tapping head
Unit 24: 24-spindle tapping head

RIGHT-HAND

Unit 25: 17-spindle drilling & counterboring
Unit 26: 22-spindle drilling, reaming, & chamfering head
Unit 27: 28-spindle drilling head
Unit 28: 48-spindle chamfering, reaming, & counter-boring head
Unit 29: 46-spindle tapping head

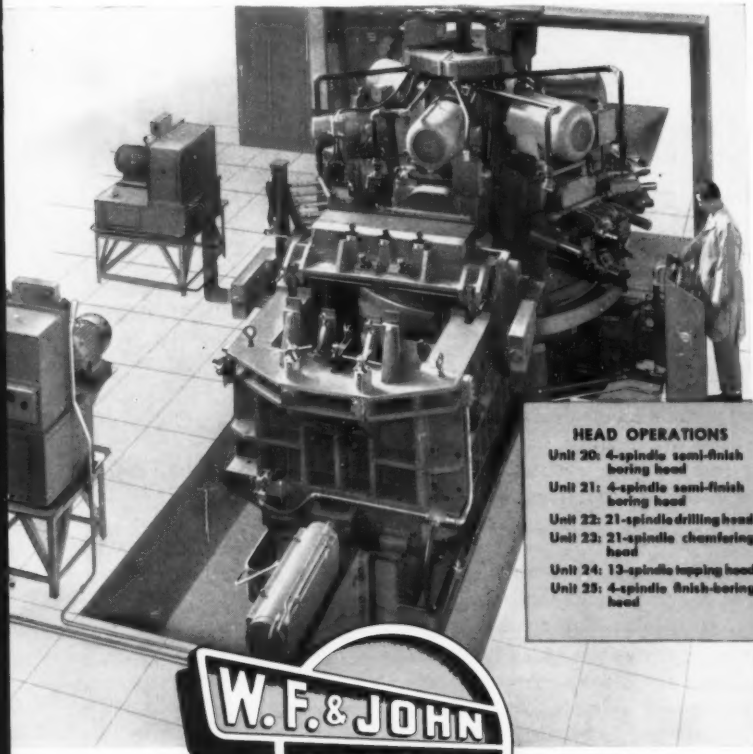
MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

NOW OFFER 3-WAY SAVINGS FOR SMALL LOT MACHINING



Versa-Matic Design Assures Greater Efficiency on Low Production, Conserves Capital Expense and Floor Space

These new W. F. & John Barnes production machines, termed "Versa-Matics," illustrate three basic applications incorporating a new, exclusive principle in machine tool engineering which now makes possible substantial savings in handling a broad range of low production work. They are designed with standard indexing tables mounting multiple-spindle heads, and are equipped with quick locating fixtures and shuttle-type feed units that move the work to the tools. Electrical contact devices for each station are mounted overhead, and are the self-cleaning type. Contacts are fully interlocked and enclosed when in operation, with remaining contacts de-energized when out of operation. The versatility of these new machines with capacity for handling more than one workpiece, offer three-way savings. For example, for a road equipment manufacturer, machines illustrated provided up to 80% savings in floor space over any other processing method, and reduced equipment cost up to 50%. Handling many operations simultaneously, achieved high efficiency with less work handling. Now, for larger and smaller work, the new Barnes "Versa-Matics" are available in a range of standard sizes to serve your specific production requirement.



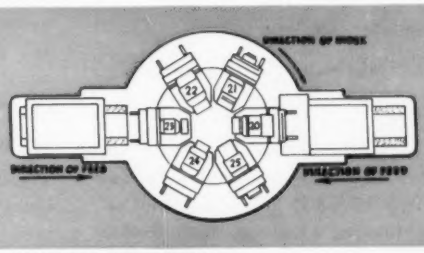
MACHINE No. 3

Standard Barnes "Versa-Matic" with Center 6-Station Rotary Table and Two Shuttle-Type Work Holding Fixtures. Drills, bores, chamfers, and taps same workpieces A, D, and E processed in Machine No. 1 and 2, and also workpieces F and G.

	Case Parts	Gear Covers
Approx. Loading Time per piece	3.00 min.	2.00 min.
Approx. Unloading Time	2.00 min.	1.00 min.
Gross Production (100% E.)	4.73 per hr.	5.00 per hr.

HEAD OPERATIONS

Unit 20: 4-spindle semi-finish boring head
Unit 21: 4-spindle semi-finish boring head
Unit 22: 21-spindle drilling head
Unit 23: 21-spindle chamfering head
Unit 24: 13-spindle tapping head
Unit 25: 4-spindle finish-boring head



WRITE FOR MORE DATA

If you have similar small lot work requiring multiple machining operations where competitive costs must be maintained, it will pay you to get full facts today on the new Barnes standard "Versa-Matics." Cost analysis will be gladly rendered without obligation.

W. F. & JOHN BARNES

Builders of Better Machines Since 1872

W. F. & JOHN BARNES COMPANY

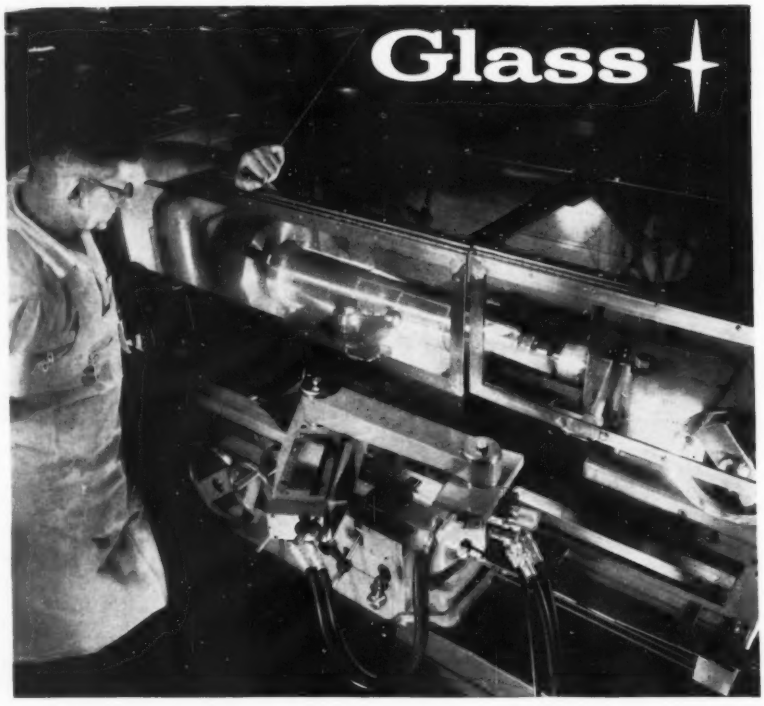
402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress-Thru Transfer-Type Machines

FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.

Barber-Colman's new 36-speed tracer lathe shows startling results on short-run work. Total costs slashed at speeds which give 30-minute tool life.

Tracing Under Glass



Here is evidence that general-purpose lathes designed for carbide-ceramic speeds are one of the most profitable investments you can make.

The reason lies in the expendability of carbide inserts. Economical machine speeds with throwaways are far beyond those recommended in machinability tables. Speeds between 600 and 900 sfm, calculated to yield 30-minute tool life, reduce *total* cost per piece by as much as 80%.

An example is this 4140 steel forging — 32 in. long by 8 in. max. dia. It is step turned in 6 min. cutting time on a Barber-Colman 36-speed lathe. A hot stream of chips makes it necessary to shield the entire work area, a requirement for which the front-mounted tracer offers definite advantages. Thirteen different diameters are turned and two ends faced at 600 sfm, with .020-ipr feed and 1/4 in. depth of cut. Turning is done by a 1/2-in. triangular carbide insert. Floor-to-floor time is 19 minutes against the former time of 2.1 hours.

The objective in setting feeds and speeds was 30-min. tool life (per edge). But, even at 600 sfm, longer life is experienced due to the machine's unusual rigidity.

More examples . . .

Other jobs being turned at ultra-high speeds include long lead screws — 750 sfm at 1/16 in. depth of cut and .018 ipr feed. The machine turns out three times as much work as two lathes formerly used. In another step-turning operation, tests already prove a 52% gain over the previous time with tracer, and the maximum processed rate has not yet been established. These are savings on jobs averaging 6 to 50 pieces.

Versatile tooling . . .

This hydraulic tracer offers two advantages for increasing utilization of a lathe. *First*, it will duplicate consistently within .001 in. on diameter or length, and it will operate at 90° to the work axis.

Second, the attachment can be removed and replaced by the regular compound in just 20 minutes. This versatility permits economical use of the machine for turning, boring, roughing and finishing, tracing, and both internal and external threading.

Quality features . . .

The lathe itself gives you a new combination of design features that improve performance at high speeds:

(1) Unusual rigidity is provided by the 30 in. span of the front carriage way, scientific bed webbing, 400-lb tailstock, and precision-ground spindle supported at both ends and in the middle by three sets of tapered roller bearings.

(2) Headstock is a dense, Meehanite casting which responds best to vibrations encountered at high speeds.

(3) All headstock gears are hardened and ground.

(4) Automatic pickup on the carriage simplifies positioning of the two-speed tailstock through carriage feed or traverse.

Information . . .

Write today for our new 16-page catalog showing how this new Barber-Colman precision machine can pay for itself quickly as a replacement for an old lathe.

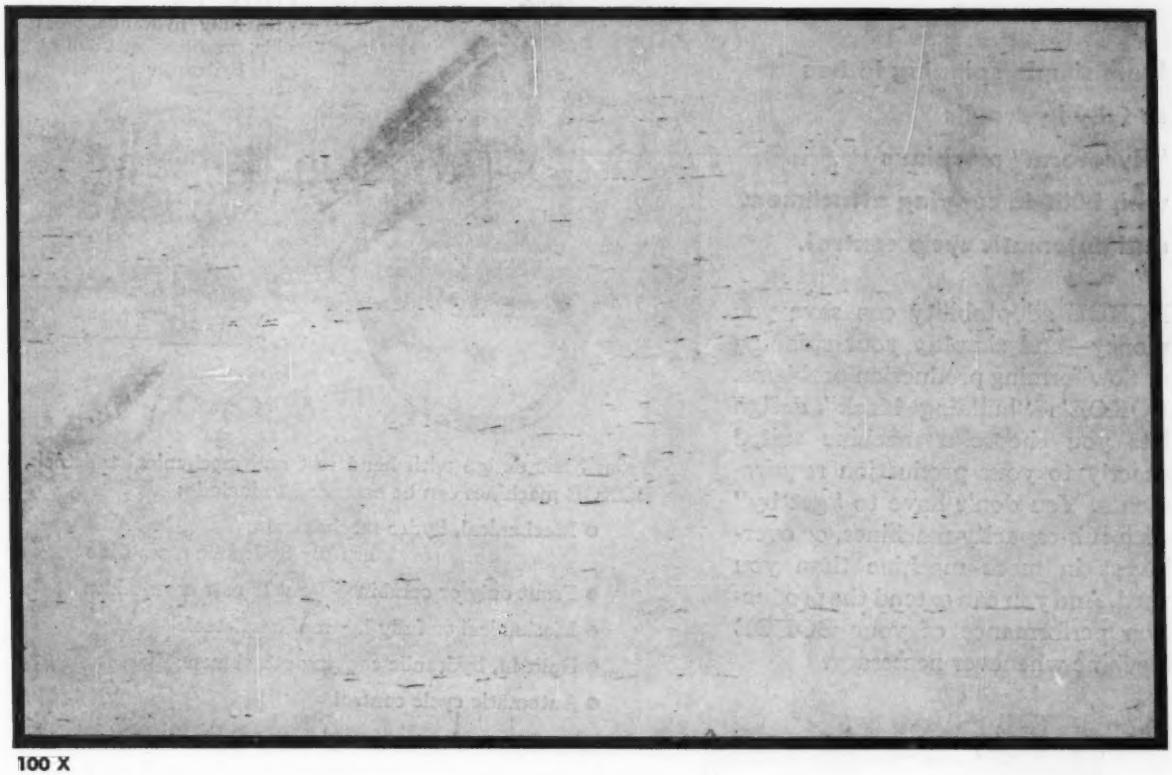
Barber-Colman Company

BARBER COLMAN ®

72 Loomis Street, Rockford, Illinois

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

Why this steel costs less to machine...



100 X

YOU'RE looking at a photomicrograph of Timken® steel that has been resulphurized to give better machinability. Those sulphides you see in the picture interrupt the chip flow, giving shorter chips and faster machine speeds.

And you get this better machinability without any sacrifice of surface quality or mechanical properties when you buy Timken resulphurized steels. Small amounts of carefully prepared sulphides are added to the molten steel under exact conditions of time and temperature. The result: Substantial improvement in machining speeds and feeds without the harmful side effects (on surface and properties) found in ordinary resulphurized steels. And when you buy Timken fine alloy steel, you're assured of uniformity from bar to bar, heat to heat, and order to order.

If you're looking for a way to reduce machining costs on parts made from seamless tubing, bar stock, or forgings, call your nearest Timken sales office. Timken resulphurized steels are available in most grades of alloy steel. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

WHEN YOU BUY TIMKEN STEEL YOU GET:

1. Quality that's uniform from heat to heat, bar to bar, order to order
2. Service from the experts in specialty steels
3. Over 40 years experience in solving tough steel problems

TIMKEN® *Fine Alloy* STEEL

TIMKEN ALLOY STEEL AND SEAMLESS TUBING IS AVAILABLE FROM STEEL SERVICE CENTERS IN 44 CITIES IN THE UNITED STATES

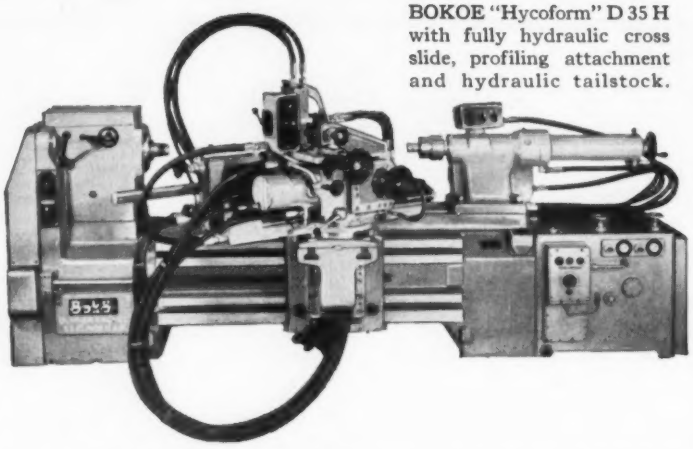
For more data, circle this page number on inquiry card

You can Adapt BOKOE

Flow Forming & Spinning Lathes To Your Exact Production Needs

From simple spinning lathes to fully hydraulic "Hycoform" machines with built-in copying attachment and automatic cycle control.

BOKOE adaptability can save you money—and simplify your spinning or flow forming production problems. BOKOE's "building block" design lets you choose a machine suited exactly to your production requirements. You don't have to "get by" with sub-capacity machines, or over-invest in more machine than you need. And you can extend the production performance of your BOKOE machine whenever necessary.



BOKOE "Hycoform" D 35 H with fully hydraulic cross slide, profiling attachment and hydraulic tailstock.

From basic design with hand rest and mechanical tailstock, BOKOE machines can be extended to include:

- Mechanical, hydro-mechanical or fully hydraulic cross-slide
- Front only or combined front & rear cross-slides
- Mechanical or fully hydraulic tailstock
- Built-in, hydraulic copying attachment
- Automatic cycle control

There's a BOKOE machine for every type of spinning and flow forming operation—for light and heavy work on ferrous and non-ferrous materials—for cylindrical and conical shapes and nose cones used in aircraft and missile applications.

- Flow forming of Aluminum up to $\frac{3}{8}$" thickness
- Flow forming of soft steel up to $\frac{1}{4}$" thickness
- Swing up to 86" maximum
- Longitudinal slide movement of 40"

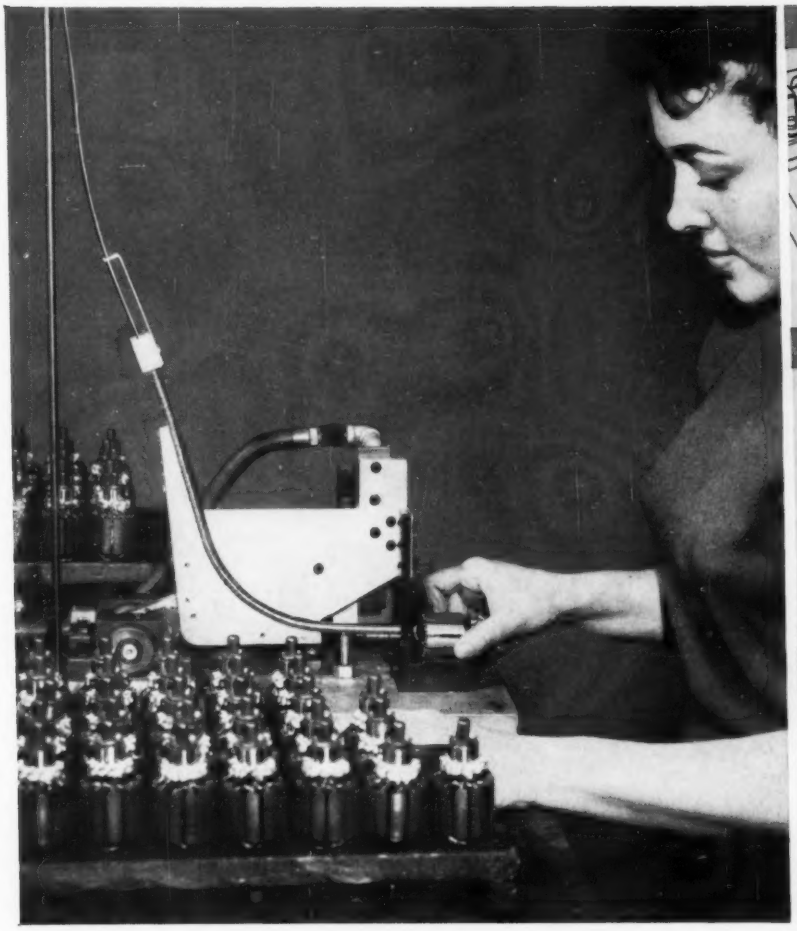
BOKOE Light Spinning Lathe D 35 L with hand rest and mechanical tailstock.

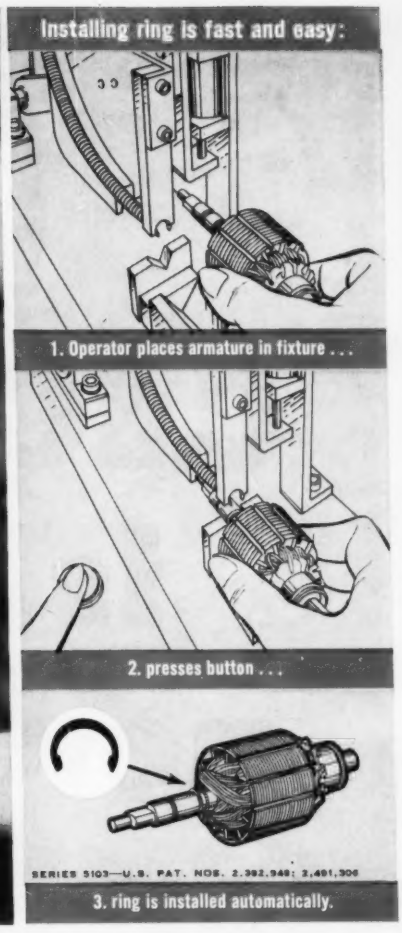
Write For Information

COSA — *nationwide sales and service of precision machine tools—from bench lathes to boring mills.*

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

IN CANADA Contact COSA CORPORATION of Canada, Ltd., 1160 Lakeshore Road, Long Branch, Toronto 14, Ontario




Installing ring is fast and easy:
1. Operator places armature in fixture . . .
2. presses button . . .
SERIES 5103—U.S. PAT. NOS. 2,392,948; 2,491,306
3. ring is installed automatically.

Mechanized Truarc ring installation speeds assembly

eliminates costly shimming and gauging operations

Fast, semi-automatic assembly and the elimination of costly production operations are among the benefits Leece-Neville Co., Cleveland, Ohio, derives from the use of Truarc retaining rings in the manufacture of its fractional horsepower automotive motors.

Radially-assembled Truarc Series 5103 Crescent® rings—supplied pre-stacked—are used to position and lock the armature in the motor housing. Using the special Truarc pneumatic applicator-dispenser illustrated above, the operator merely inserts the rotor and presses a release button. The ring is installed automatically in a pre-cut groove on the rotor shaft!

The precision manufactured Truarc rings, seated in accurately located grooves, reduce accumulated tolerances from a possible maximum of .184" to .025". Costly, time-consuming shimming operations previously necessary to take up end play are eliminated, together with as many as four gauging operations required to select and place the shims.

The Leece-Neville story is just one example of the way Truarc retaining rings are stepping up production on today's fast-moving assembly lines. These versatile fastening devices simplify design, speed assembly and eliminate rejects. In replacing conventional fasteners, they often improve product performance and reliability. All of these advantages are in addition to substantial cost savings!

Truarc retaining rings come in 50 functionally different types . . . up to 97 different sizes within a type . . . 6 metal specifications and 13 finishes. Special Truarc hand, magazine and automatic applicators and grooving tools make production-line application easy on virtually every type of product. Make sure you have on file the new 16-page Truarc assembly-tool catalog No. AT 10-58. Write for your copy today. And remember Waldes Truarc engineers are always ready to assist you with your special production problems. Write: Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, New York. 9.13

WALDES
TRUARC®
RETAINING RINGS
Waldes Kohinoor, Inc., Long Island City 1, N. Y.

TRUARC RETAINING RINGS . . . THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

©1959 WALDES KOHINOOR, INC.

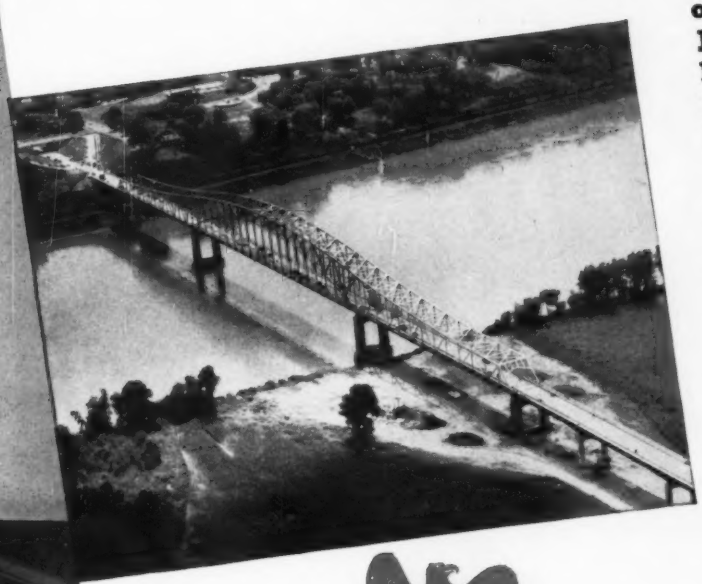
The CECO-DROP is setting new records -for lower costs -for higher production

← **Chambersburg's new 28 page forge shop modernization bulletin. Based on studies made in prominent forge shops, this publication assists you to formulate your own step-by-step modernization program. Write for a copy today.**

CHAMBERSBURG ENGINEERING COMPANY · · CHAMBERSBURG, PA.

THE THOUSANDS OF HOLES

required in the construction of the recently completed Jefferson City, Missouri bridge by Stupp Bros. Bridge and Iron Company, of St. Louis, Missouri, were all drilled by "AMERICAN" Hole Wizard Radials.



One of the oldest and largest bridge builders and steel fabricators of the Middle West, Stupp Bros. use "AMERICAN" radials exclusively for their drilling operations. Their main reason for using "AMERICAN" exclusively is LOW COST PER HOLE.

Quick Handling—Fast Penetration—Low Maintenance are the prominent contributing factors.

"AMERICAN" Radials can be relied upon to pay excellent returns upon the user's investment.

Ask for Bulletin No. 328.

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

BUSINESS IS UP

Get your share and keep it there!

Threadwell
MAKES THE BEST PRODUCT BETTER

INDUSTRIAL DISTRIBUTORS
SERVING INDUSTRY ECONOMICALLY
THE RIGHT HAND OF PRODUCTION

Threadwell's fine line of cutting tools and gages is one guarantee of uninterrupted production, the surest way to stay in a competitive position.

To get out front and stay there make sure you include your Threadwell Distributor in your production planning.

THREADWELL TAP & DIE CO.
GREENFIELD, MASSACHUSETTS

Stocking Warehouses: New York — Cleveland
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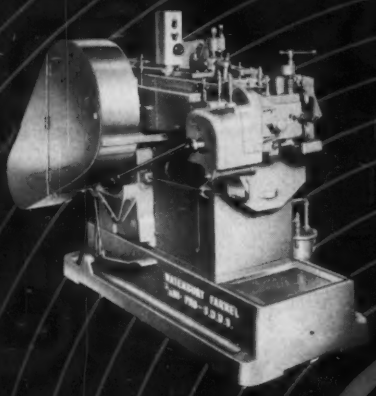
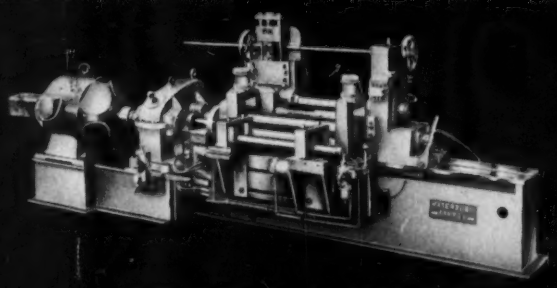
COLD HEADING
MACHINERY





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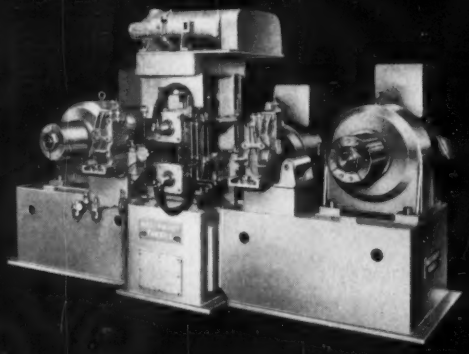
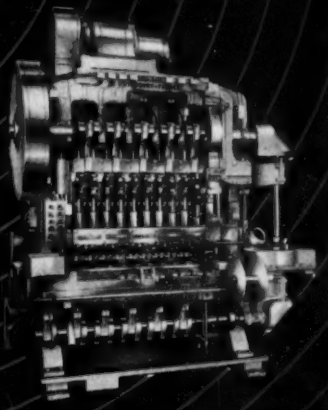
& WIRE
MACHINERY

WATERBURY FARREL
MACHINERY BUILDERS

ROLLING MILL
MACHINERY





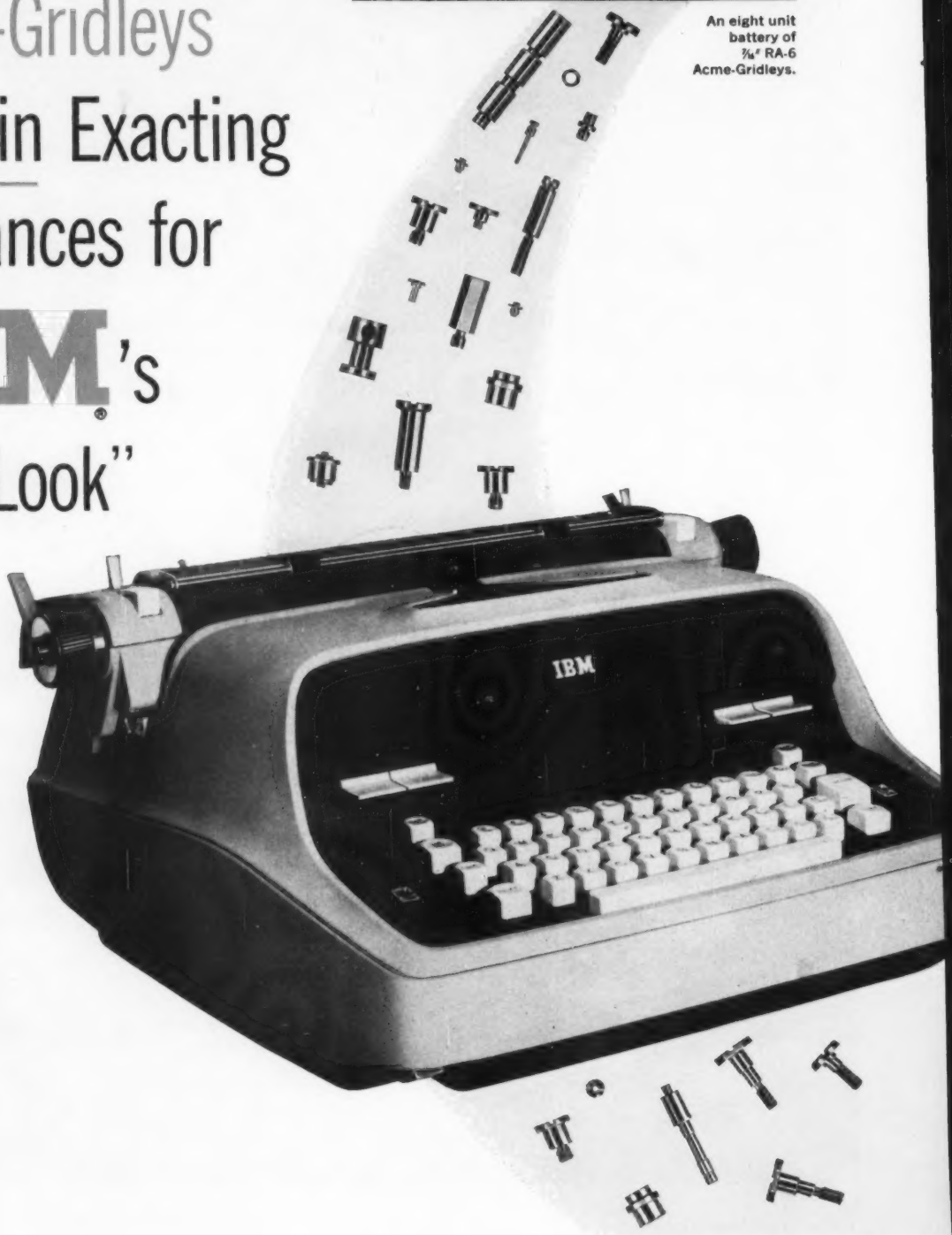
POWER
PRESSES

THE WATERBURY FARREL FOUNDRY & MACHINE CO.
DIVISION OF TEXTRON INC.
Waterbury, Connecticut • U.S.A.
Sales Offices: Chicago • Cleveland • Los Angeles • Millburn, N. J.

First Precision Component
in the Run . . . or Last

Acme-Gridleys Sustain Exacting Tolerances for IBM®'s "New Look"

An eight unit battery of ¾" RA-6 Acme-Gridleys.



Close-up of rear side of tooling zone showing slotting attachment in the 5th position.

At IBM's modern Lexington, Kentucky plant, twenty Acme-Gridley 7/16" six spindle automatics are mass-producing the small to miniature parts for their sleek new electric typewriter. They help to provide IBM with greater *sustained* accuracy at lower cost than other comparable machines.

The precision components are held to closely controlled tolerances of .0005 t.i.r. These limits apply to the last piece in the run as well as the first, and consistent accuracy is maintained with less machine adjustment than ever before realized. Sustaining the closely controlled tolerances of these parts completely minimizes costly rejections during exhaustive quality control checks of the completed units. Inspection time is greatly reduced.

IBM has also found that the wide-open tooling zone of their 7/16" Acme-Gridleys permits much greater latitude in tooling up for complicated operations performed in a single set-up. This, plus the lasting accuracy of direct camming and the flexibility of independently operated toolslides, makes this newest member of the Acme-Gridley family a profitable asset to IBM's modern production line. Write for Bulletin MRA-58.

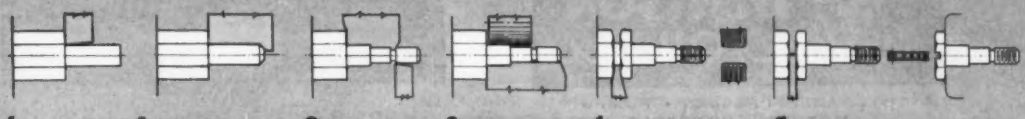
Pioneer in Circumferential Automation

National Acme

The National Acme Company
179 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

9 Operations in 4.9 Seconds



6. Rough Turn Front End
1. Rough Form and Chamfer Front End
2. Finish Form Two Diameters Finish Turn Thread Diameter
3. Shave Three Diameters
4. Breakdown for Cutoff-Thread
5. Cutoff-Pickup and Slot

How **DENISON MULTIPRESS** cuts costs of **COMPACTING**

Production tripled with **DENISON** Multipress in compacting shaped charges at **JET RESEARCH**

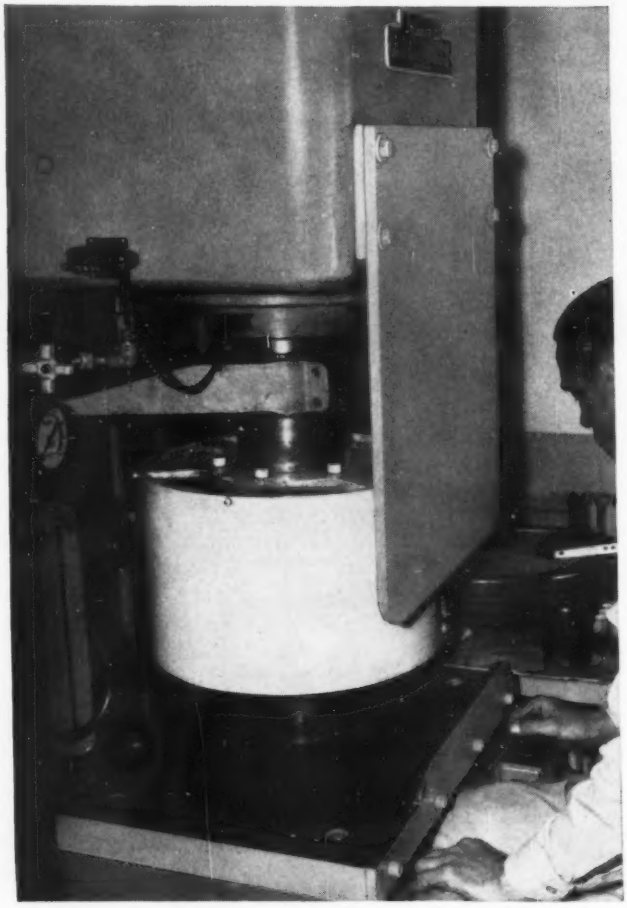
...scrap virtually eliminated by precise control of density obtained hydraulically

Density in compacting explosives is being duplicated exactly at Jet Research Center, Inc. with Denison hydraulic Multipresses. Formerly done on mechanical presses, production has now been tripled to cut manufacturing costs substantially.

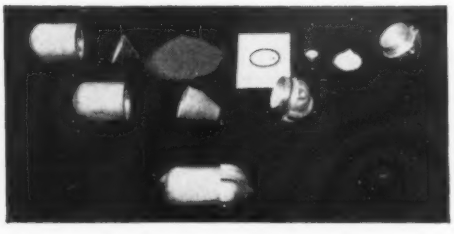
In the production of the shaped charge assembly, a precise amount of explosive is automatically weighed out, placed in a container and loaded in a die. With one, smooth stroke of the hydraulic ram, the charge is compacted to exact density. This density is duplicated from charge-to-charge because the ram will not reverse until its preset pressure is reached.

Production runs in excess of 2,000 assemblies-per-day for Multipress with a minimum of operator training.

Whatever your compacting job or assembly operation may be, savings like these could be duplicated in your plant. Ask the Denison Specialist to show you how. And write today for a descriptive catalog on the complete Multipress line.



300% increase *in production of compacted powders is attained with Denison hydraulic Multipress at Jet Research Center, Inc., Arlington, Texas.*



Components for assembly *of shaped charges used in perforating oil and gas wells.*

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1152 Dublin Road Columbus 16, Ohio

Denison Stocking Branch Offices: CHICAGO • DETROIT
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DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS
MOTORS • CONTROLS

59-28

IT'S 'TUNE-UP' TIME FOR PRODUCTION MACHINES!

How long has it been since you "raised the hood" of your Ex-Cell-O production machines? Even the most reliable equipment will run faster, more accurately and *longer* after a thorough going-over by skilled Ex-Cell-O machine repairmen.

Ex-Cell-O machines returned for renewal, repair or modernization are carefully inspected, disassembled and reworked from base to bridge, with new machine accuracies. The products of preferential treatment, they move right alongside the newest Ex-Cell-O machines, rejuvenated by the familiar touch of the men who know your Ex-Cell-O machines best—the men who build them.

Necessary replacement parts are Ex-Cell-O "original equipment" quality; rewiring or re-worked controls conform to JIC standards; tables and ways are hand-scraped to their level-best; coolant and lubricant systems are restored to full efficiency, spindles are trued, and tooling can easily be up-dated to your specifications.

Call your local Ex-Cell-O Representative, or write direct for details on how your older Ex-Cell-O machines can be economically "tuned" to today's production demands.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

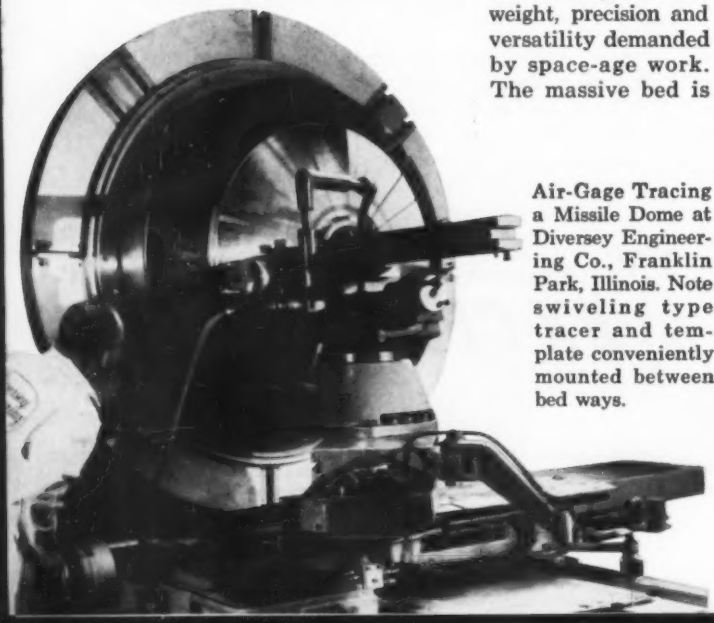
Ex-Cell-O Precision Products Include: Machine Tools • Grinding and Boring Spindles • Cutting Tools • Railroad Pins and Bushings • Drill Jig Bushings • Torque Actuators • Thread and Groove Gages • Granite Surface Plates • Aircraft and Miscellaneous Production Parts • Dairy Equipment

For more data, circle this page number on inquiry card

6 THE MISSILE MASTER—finest of the

This is *the* lathe for you—if you are interested in the contour turning, boring and facing of missile components or other large thin-walled and fabricated parts.

As these photos tell you, this machine is BIG. And it's newly-designed for size from the floor up with the weight, precision and versatility demanded by space-age work. The massive bed is 54" wide, with extra-wide, flame-hardened and ground carriage ways. And you can almost feel the strength in the specially-designed headstock, carriage, slides and tailstock.



Air-Gage Tracing a Missile Dome at Diversey Engineering Co., Franklin Park, Illinois. Note swiveling type tracer and template conveniently mounted between bed ways.

EXCLUSIVE PERFORMANCE FEATURES

The swiveling type Monarch Air-Gage Tracer generates complex shapes in an extreme contour range with an efficiency unequalled through any other means. Its unrivalled accuracy of reproduction is of the greatest value when working with high strength alloys, in complex thin-walled sections which must be machined to ultra-close tolerances and critical surface finishes. You'll like the template mounting between the bed ways. This permits easy adjustment from the front of the machine. Template tool control is possible over work diameter variations up to 70".

Large diameter work requires low spindle speeds. Augmenting the spindle drive, the time-proved, exclusive Monarch face plate drive assures full power applied far out from the work axis. This also widens the speed range, affording a choice of 24 speeds. Constant surface cutting speed control over a 4 to 1 range is available.

for Tomorrow's Boom with Yesterday's Lathes

MONARCH SPECIAL PURPOSE LATHES OF TOMORROW

The Monarch Missile Master. Swing over bed, 85"; swing over cross slide, 67". Length between centers in increments of 48", up to 300".

space-age giants—*New* from the floor up

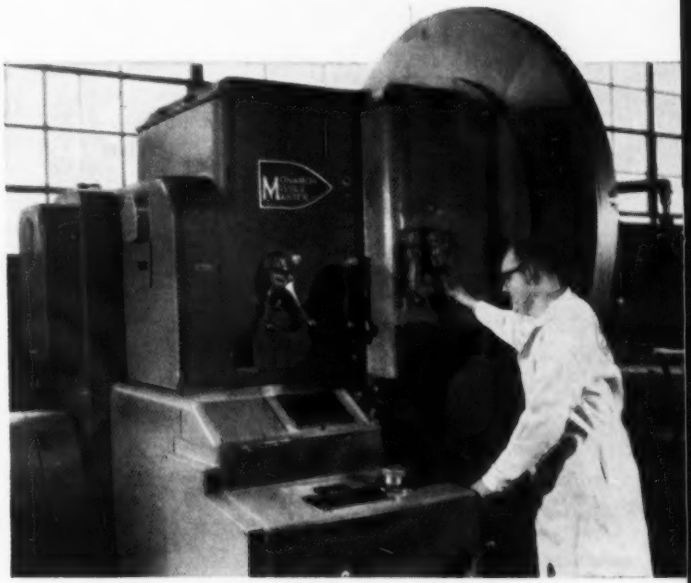
CHECK THE FIELD

We invite your comparison of the Missile Master to any other lathe that might be considered in its class. Send for our Specification Brochure #2101. Then—if you really want to get your space-age work off the ground—make floor-space for the Missile Master! . . . The Monarch Machine Tool Company, Sidney, Ohio.

MISSILE MASTER APPLICATIONS

Missile Parts: Nose sections, nozzles, motor cases, bulkheads, air frame sections, hemispherical or elliptical domes.
Other Parts: Any large, thin-walled and fabricated parts: rolls, cylinders, spiders, jet engine components, valve gates, electrodes, etc.

Monarch
TURNING MACHINES



We Don't Expect a Boy to Do a Man's Work! Look at that massive face plate drive headstock. Gear box is totally enclosed as you would expect on a modern lathe.

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

Inspect your gears the practical, low-cost way

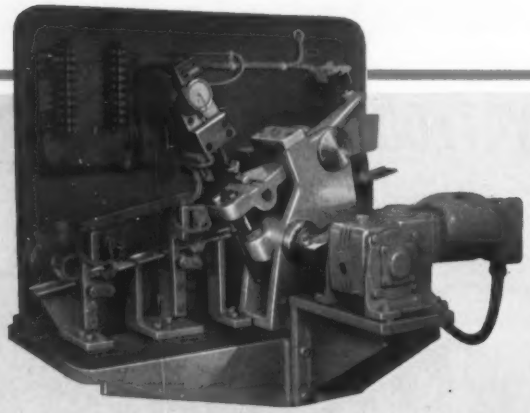
Many gear makers favor Red Ring gear inspection machines because they are precise without being delicate or temperamental — equally effective in either the gear laboratory or the busy production shop. Just practical and economical.

Red Ring machines provide for such Automatic Operations as:

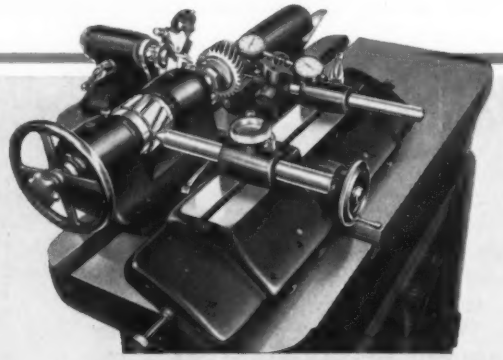
- Gaging of size and helix angle
- Sorting according to size and helix
- Recording of gear measurements

Red Ring machines also check such individual gear characteristics as Index, Eccentricity, Wobble, Lead or Helix, Size and Tooth Parallelism.

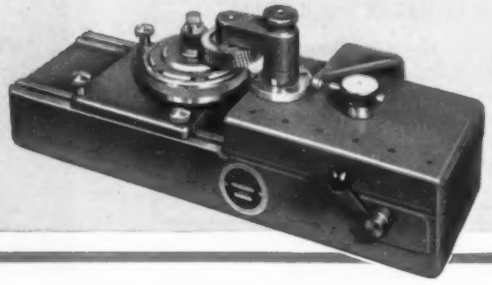
We can't show here the many models now in service throughout industry, but you may have Bulletin C-55-9 which describes them in detail. Why not write for it today?



Automatically checks tooth size of gears with integral flanges too large to pass through conventional feed chutes. In-tolerance, oversize and undersize parts are segregated. (Machine cover removed)



Lead Comparator with an additional interchangeable head for measuring other tooth characteristics. (Tooth spacing head shown)



Rolling fixture provides a rapid check of composite errors and tooth surface roughness.

8287

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING, GEAR HONING AND ELLIPTOID

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN . . DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

For You?

FEDERAL

has supplied precision gaging for:

- THOR
- BOMARC
- FALCON
- SPARROW
- ATLAS
- CORPORAL
- NIKE
- MATADOR
- DART
- NAVAHO
- FIREBEE

Yes

if you have a responsibility in controlling the dimensional conformance of missile components.

This is an up-to-the-minute technical brochure on gaging as used to control quality in critical missile parts now being manufactured. With photographs, diagrams, and informative data it shows how certain challenging problems have been successfully overcome by combining Federal's specialized gage experience with the know-how of the customer's Engineering Dept. (and with that of the machine tool manufacturers when new machines or tooling is involved).

Each gage is clearly illustrated and the dimensions or dimensional conditions being checked (parallelism, squareness, co-planerity, concentricity, center-distance, straightness, etc.) are described and diagrammed. In addition to strictly dimensional gages, the brochure includes also descriptions of gages for machine set-up and for critical assembly operations.

We will be pleased to send a copy of this brochure to you.

FEDERAL PRODUCTS CORPORATION
9117 Eddy Street • Providence 1, Rhode Island

Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

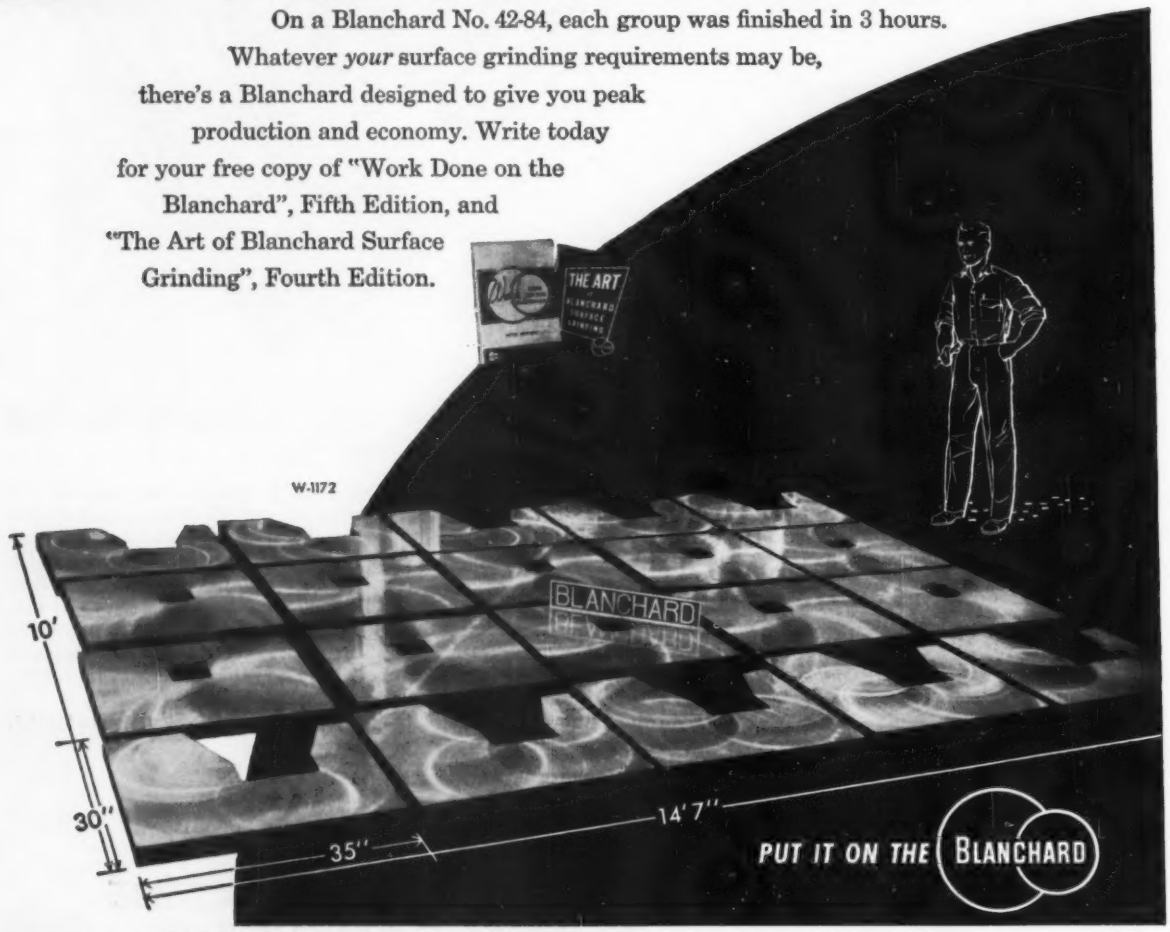
For more data, circle this page number on inquiry card

Grinding Perfection is Assured When You "Put it on the Blanchard"

V-517

The production speed and precision of modern Blanchard Surface Grinders are illustrated by this interesting job, involving 20 plates measuring 30″ x 35″ x 3″. Ten of them had openings of 6½″ x 4″, the other ten had openings of 11″ x 20″. Each group of plates required stock removal of 5/32″ from two sides, with flatness of .003″. On a Blanchard No. 42-84, each group was finished in 3 hours.

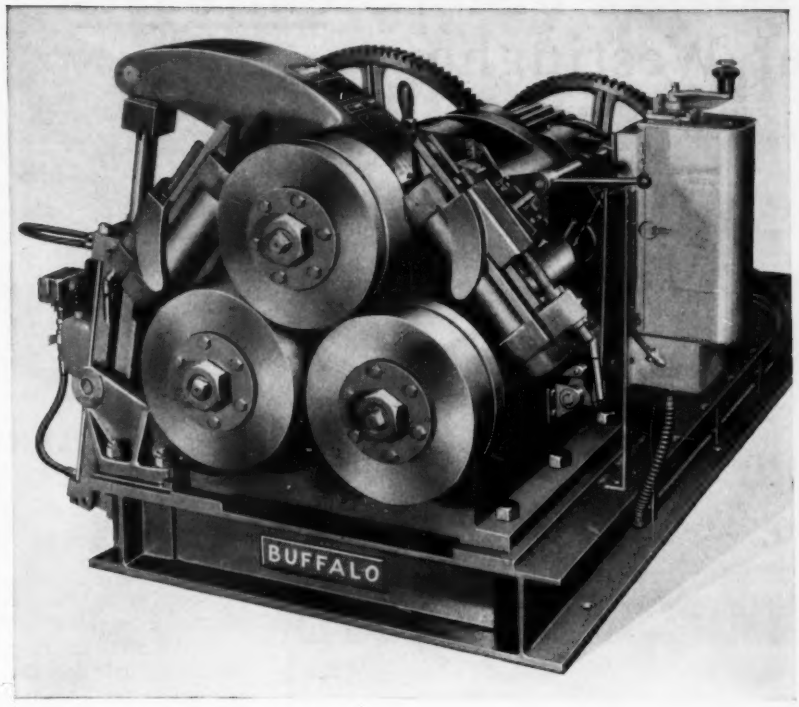
Whatever *your* surface grinding requirements may be, there's a Blanchard designed to give you peak production and economy. Write today for your free copy of "Work Done on the Blanchard", Fifth Edition, and "The Art of Blanchard Surface Grinding", Fourth Edition.



W-1172

THE BLANCHARD MACHINE COMPANY 64 STATE ST., CAMBRIDGE 39, MASS., U. S. A.

Turn Your TOUGH Bending Jobs into PROFITABLE Operations with "BUFFALO" BENDING ROLLS



"Buffalo" Bending Rolls have taken production bending operations "out of the red" and put them "in the black" in literally hundreds of shops.

Fast, accurate and easily-operated, they are ideal for rapid circle, segment and spiral bending. Versatile, they handle angles, rounds, squares, tubes, beams, channels, flats and special shapes. Rolls are quickly and easily changed for different structural shapes and setup changes. With the unique "Buffalo" hydraulic adjustment for the top roll, the upper roll is effortlessly positioned or released to save vital setup time.

Exclusive "Buffalo" "Leg-In" Attachment saves you time and money! Difficult bending of angles leg-in is greatly speeded and simplified. Material will not twist or get out of square. This feature also acts as a gauge when rolling a number of circles to the same diameter.

Choose from a wide variety of "Buffalo" Bending Rolls in many sizes designed to handle a range of work from the heaviest members down to the smallest fabrication jobs. Call in your "Buffalo" machine tool dealer or use convenient coupon below.

"Buffalo" Machine Tools bring you the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

ESTABLISHED 1877 "Buffalo" MEMBER N.M.T.B.A.

DRILLING
PUNCHING
SHEARING
BENDING

BUFFALO FORGE COMPANY

440 BROADWAY • BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

I'd like more information on how I can cut costs—increase profits with "Buffalo" Bending Rolls.

NAME_____ TITLE_____

FIRM_____

STREET_____

CITY_____ ZONE_____ STATE_____

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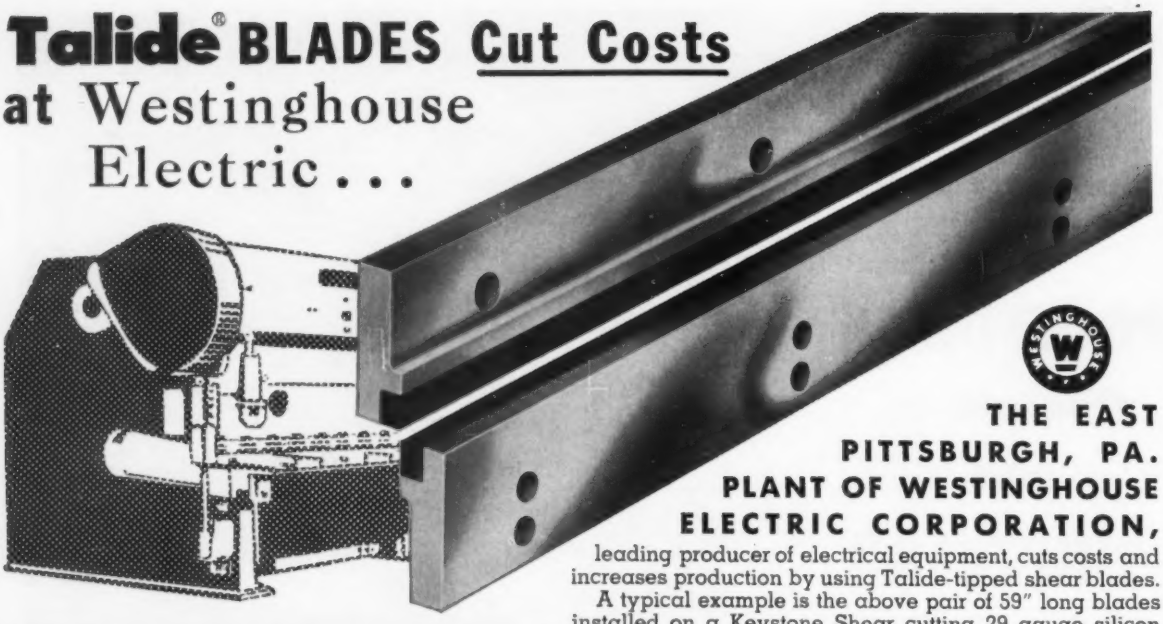
Talide® BLADES Cut Costs at Westinghouse Electric . . .



THE EAST PITTSBURGH, PA. PLANT OF WESTINGHOUSE ELECTRIC CORPORATION,

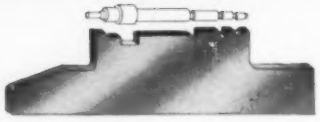
leading producer of electrical equipment, cuts costs and increases production by using Talide-tipped shear blades.

A typical example is the above pair of 59" long blades installed on a Keystone Shear cutting 29 gauge silicon steel up to 36" wide. Cutting continuously for periods up to 8 months without a regrind, approximately 5,631,000 strokes are performed at an average speed of 30 strokes per minute. 3,660 tons of metal are cut per regrind at a savings of over $2,000 alone in grinding and set-up time.

During this same period it was previously necessary to grind high-carbon, high-chrome blades 24 times — and make frequent replacement. Talide blades normally stay on the job for several years giving high-speed, continuous, burr-free production.

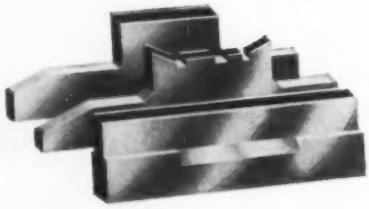
Talide blades are available in lengths up to 120" tipped with a **one-piece** carbide wear strip. There are no section or seam marks to score or scratch the metal being sheared or centerless ground. Users prefer blades of this superior construction.

CENTERLESS BLADES



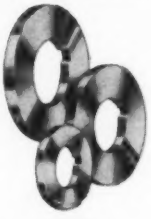
LARGE ELECTRIC MOTOR PLANT

Part.....Stainless steel rotor shaft for electric motor.
Operation...Grind 7 diameters simultaneously.
Machine....No. 12 Landis Centerless Grinder.
Blade.....Special multiple step Talide-tipped work support blade No. C-4884.
Results.....Talide-tipped blade in continuous production for 91 days (2 turns per day) compared to best previous production run of 3 days with hard alloy steel blade.



Over 50 sizes and styles of standard Talide-tipped blades carried in stock for Landis, Cincinnati and Van Norman Centerless Grinders. Special blades made promptly to order.

TALIDE ROTARY KNIVES GIVE PHENOMENAL RUN OF 90-1 . . .



A leading strip steel producer of razor blade, high-carbon, spring and stainless steel reports over 1200 coils were gang slitted with Talide knives, compared to 15 coils with steel knives. More tonnage was produced in one regrind of the Talide knives than over the entire life of a set of steel knives. Burr-free, clean-cut edges produced with scrap rate practically eliminated.

EXCLUSIVE RETIPPING SERVICE

Because of its exclusive hot press method, Metal Carbides is able to rework worn, chipped-out or broken areas of carbide-tipped blades back to original size and dimension with all breaks and defects eliminated.

METAL CARBIDES CORPORATION
MC
TALIDE®
YOUNGSTOWN 12, OHIO

HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

Ask for a Talide Sales Engineer to call— or write for 76-page 56-G catalog.

METAL CARBIDES CORPORATION
Youngstown 12, Ohio

SIX STANDARD ANSWERS TO A HUNDRED SPECIAL PROBLEMS

The line-up above represents basic models of the H-P-M C-Press line of hydraulic presses, capacities to 15-ton. Literally hundreds of daily chores fall within this tonnage range. They offer individual pressure, stroke and speed characteristics for a variety of jobs on each.

With the C-Press, every element of control is quickly and simply established by convenient adjustments. Tooling changes and individual requirements for speed, stroke and pressure can be met with minimum time and trouble.

1 **THE H-P-M 15-TON C-PRESS**
For manual or automatic cycling, fast traverse and controlled pressing, electric stroke adjustment. Compact, sturdy, completely J.I.C.

2 **THE H-P-M 10-TON C-PRESS**
Has dual electric safety controls, manual cycling, large daylight and long stroke — the bench type press for an amazing range of jobs. As with all C-Presses — J.I.C.

3 **THE H-P-M 5-TON C-PRESS**
For pressure sensitive servo control. Ram performs in direct response to manipulation of the single hand lever control. Ideal for straightening and general maintenance work.

4 **THE H-P-M 5-TON C-PRESS**
Has straight manual control — easily the most useful press you can own. Completely adjustable for all production requirements; completely dependable for everyday manual type jobs.

5 & 6 **INDEX TABLE C-PRESSES**
At the far end are two models of the versatile *Index Table C-Presses, 5-ton models*. One for six station indexing, the other for twelve. Interlocked hydraulically with the press power system, the index table places practical automation within reach of even the smallest shop. They're infinitely adjustable and adaptable to modern demands for standard simplicity, special application. They're the press line around which to build your automatic assembly operations . . . at lowest cost.

Send for informative catalogs, today. See your nearest H-P-M representative at your first opportunity.

THE HYDRAULIC PRESS MFG. COMPANY

A Division of Koehring Company • Mount Gilead, Ohio, U. S. A.

HPM

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FOR NUMERICAL CONTROL AT LOWEST COST

Illustrated here is a Gorton Mastermil with O-16A Super-Speed Spindle Head and Ram Assembly with G. E. Mark II Numerical Control System

GORTON NUMERICAL CONTROL

is field tested and proved in use

This is how Gorton Numerical Control saves you money on short runs:

- — eliminates elaborate and costly tools, dies, jigs and fixtures
- — wastes no time because operator does not "pace" the work
- — makes no mistakes because operator skill not required
- — extreme, repetitive accuracy is easy and automatic
- — change overs in set-ups can be made quickly
- — signals operator when tool changes are needed
- — guides cutter in close quarters without damage to work or cutter
- — making punched tape is simple typewriter operation

Punched tape . . . or magnetic tape control . . . is available to you on SIX standard Gorton machines and also on Gorton custom-designed machines. You'll be agreeably surprised when you learn the low cost of Gorton Numerical Control and how much more it gives you for your money. For full information write

Saves You Money on —

- face milling
- side milling
- end milling
- straight line cavity milling
- slotting
- drilling
- reaming and boring

Your letterhead inquiry will receive prompt attention.

GORTON

SINCE 1893

GEORGE *GORTON* MACHINE CO.

1307 Racine St. • Racine, Wis.

Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.

Aluminum or zinc clad steel by production metallizing

- *any shape or size*
- *unlimited thickness*
- *no heat distortion*

Modern metallizing provides the product engineer with an extremely flexible, practical method of producing aluminum or zinc clad steel parts. High speed, automated metal spray equipment applies these coatings to practically unlimited thicknesses on any shape or size part without heat distortion.

a typical example

problem: **provide uniform heat distribution on thin steel shell**

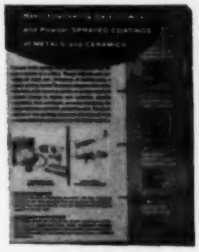
The excellent sanitary qualities of stainless steel make it an extremely desirable material for cooking utensils. But with the comparatively thin, drawn shells (.020" to .050"—varying by manufacturer), uniform distribution of heat presents a problem.

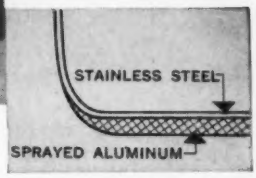
The solution is being provided for a number of high-volume manufacturers by metallized aluminum. Surface preparation is by grit-blasting as the shells rotate on a spindle. Metco Aluminum is then sprayed on the bottom, with automated traverse equipment, to closely controlled thicknesses (from .040" to .120", depending on the particular utensil and its manufacturer). The sprayed aluminum is carried up the sides beyond the radius and is tapered off according to individual design.

This is but one of many solutions to fabrication problems offered by sprayed metals to design engineers. In addition to the aluminum example given, zinc is also commonly used for corrosion-proofing in many production applications, such as steel capacitor cases, refrigerator parts, pole line hardware, etc. Sprayed zinc is also used to replace coatings burned, threaded, or machined off during fabrication.

For a round-up of some typical applications and engineering data on the characteristics of metallized coatings, write for Bulletin No. 136-A.

FREE BULLETIN ▶





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Mr. Donald A. Watson
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Company

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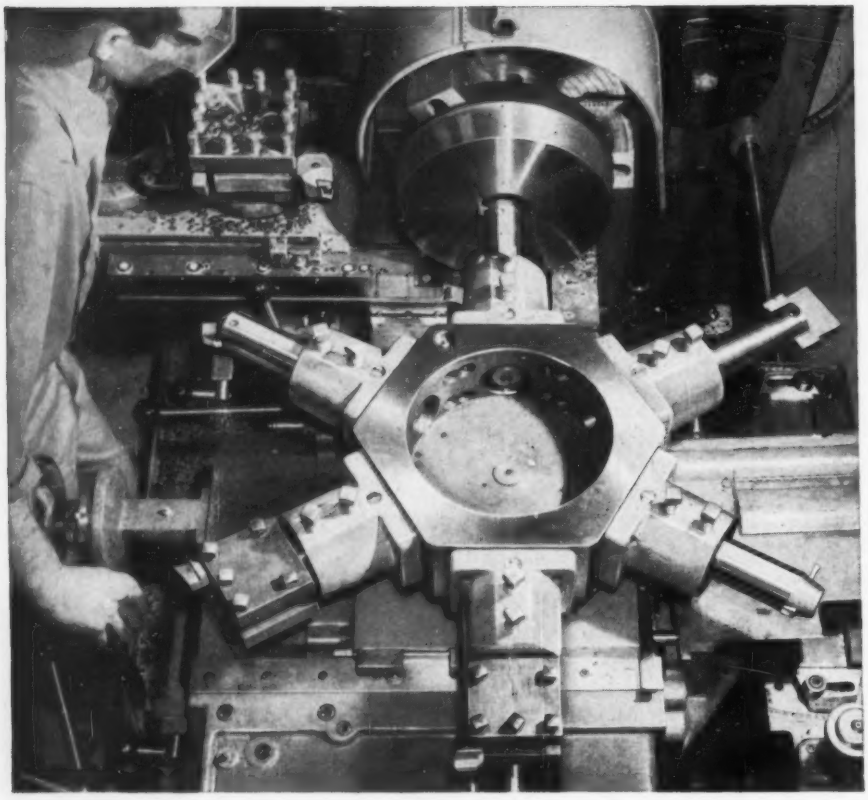
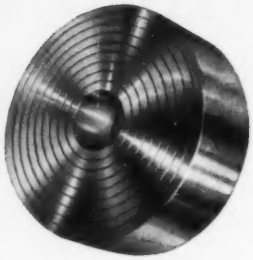
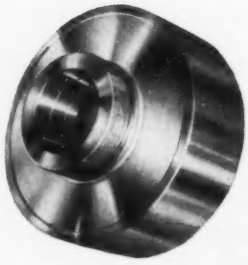






Expert setup gets more work per chucking

How manufacturer uses C/F turret lathe to produce variety of chuck bodies with only one tool change

To do the job, the manufacturer selected a Gisholt 1L Saddle Type Turret Lathe with a cross-feeding hexagon turret. A 15″ 3-jaw air chuck holds down chucking time. One set of adjustable serrated jaw bases handles the different workpiece sizes for first machining operations. A quick-indexing square turret on the cross slide carries turning, facing and chamfering tools, which work simultaneously with tools on the hexagon turret.

Three stub boring bars on the hex turret bore, counterbore, recess and back face. Because size is set with the cross-feeding turret, these same boring bars are used on different part sizes. Also on the hexagon turret are 2 box-type tool posts for facing, boring or recessing—used for different size workpieces because of the cross-feeding feature. A threading attachment lets the manufacturer thread the hubs, and a taper attachment handles up to 8 inches taper per foot when required.

The sixth tool on the hex turret, a spade cutter, is used for final sizing and is the only special tool changed for each job.

Simple, low-cost tooling combined with the cross-feeding hexagon turret offers maximum efficiency in handling various sizes of similar parts. The rugged Gisholt MASTERLINE Saddle Type Turret Lathes have the speeds, feeds and power to complete the work in the least amount of time. Call your Gisholt Representative today, or write Gisholt for literature.

MASTERLINE GISHOLT SINCE 1887 GISHOLT

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

WRITE TODAY for complete set of Gisholt MASTERLINE Saddle Type Turret Lathe Bulletins.

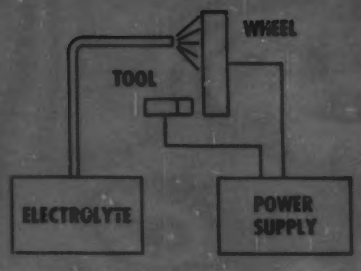
TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • PACKAGING MACHINES • MOLDED FIBERGLAS PLASTICS

NEW

Reciprocating Electrolytic Tool Grinder

MICRO-FINISHES CARBIDES, CUTS DIAMOND-WHEEL WEAR 80%

59-25



ELECTROCHEMICAL METAL REMOVING "LETS THE ELECTROLYTE DO THE GRINDING"

As conductive, metal-bonded wheel reciprocates across face of tool, inexpensive salt-solution flows between the tool and the wheel, creating electrolytic cell; the tool becomes the anode. Material is removed essentially as in a deplating process—but at much higher speed—leaving burr-free finish.

Because its reciprocating wheel just "wipes away" the carbide particles, Ex-Cell-O's Style 264 Electrolytic Tool Grinder reduces diamond wheel consumption by as much as 80 per cent! With one set-up, tools can be precision-finished to better than 15 micro-inches—free from heat checks, cracks or burns caused by abrasive contact.

The Style 264 grinds the cutting edges of carbides and other super-hard tool materials at one end, grinds chip breakers at the other. Wheel stroke is fully adjustable. Standard equipment includes: Ex-Cell-O Precision Spindle with inbuilt reversible motor, universal chip breaker fixture (shown in circled inset, above), and pressure system for electrolyte.

Write direct, or see your Ex-Cell-O Representative for details on the Style 264, conventional Style 142 Reciprocating Tool Grinder, and others in the complete Ex-Cell-O line.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

XLO
EX-CELL-O FOR PRECISION

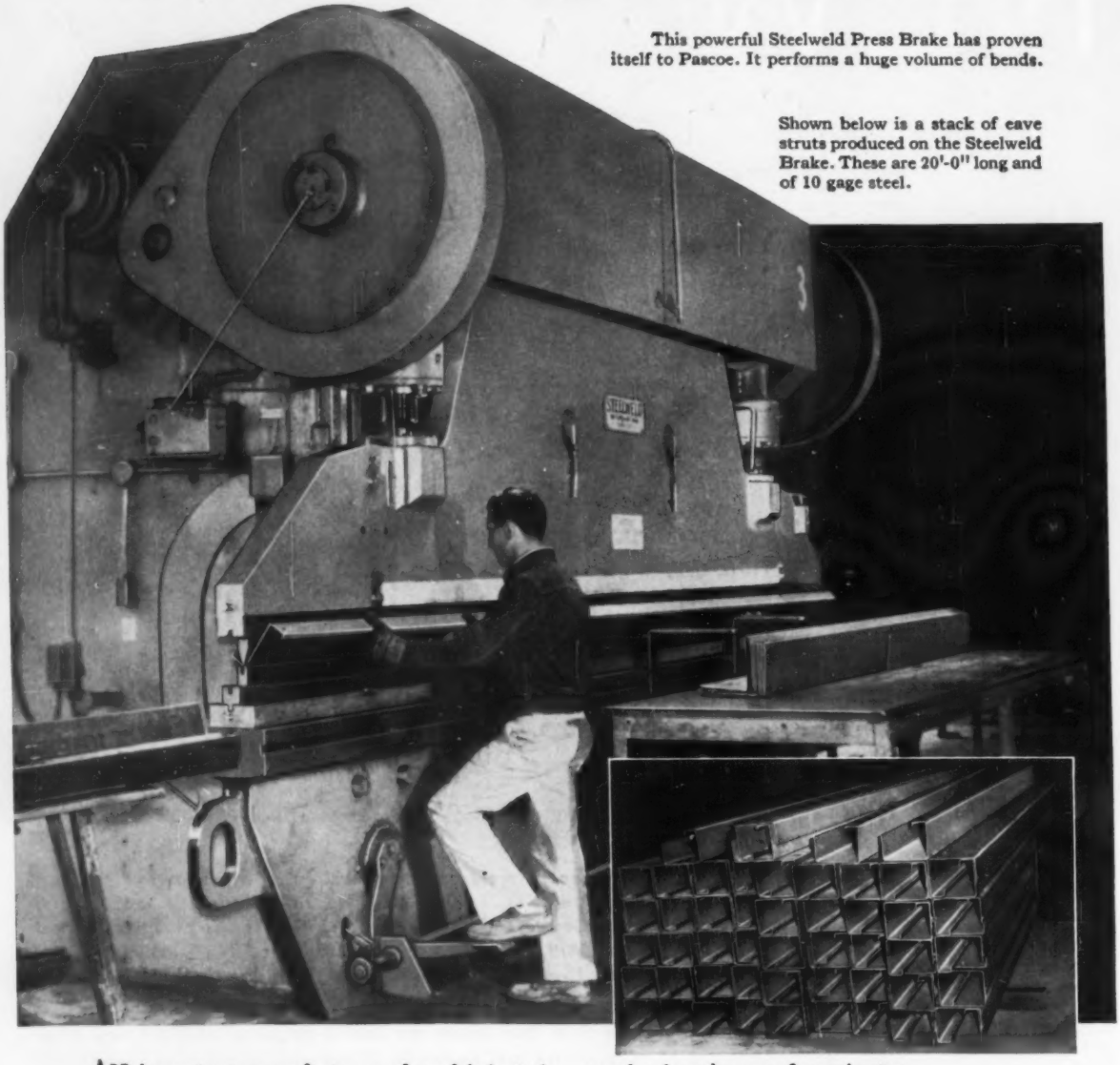
Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

STEELWELD BRAKE
AIDS PASCOE BUILDING PRODUCTION

This powerful Steelweld Press Brake has proven itself to Pascoe. It performs a huge volume of bends.

Shown below is a stack of eave struts produced on the Steelweld Brake. These are 20'-0" long and of 10 gage steel.



AN important manufacturer of prefabricated steel buildings on the West Coast, the Pascoe Steel Corporation, Pomona, California, keeps their Steelweld Press Brake going full tilt in order to keep up with the production schedule.

The brake normally handles steel up to 20'-0" x 3/16", although occasionally 1/4" metal is formed. It has the speed and power to produce sharp accurate bends at a fast rate.

Despite all the work put through, only the meagerest amount of maintenance is required. For instance, the clutch has had to be adjusted only once, every eight-month period and this can be done in very few minutes.

Pascoe builds a complete line of pre-engineered buildings which are used for warehouses, light manufacturing, grain storage, auditoriums, aircraft hangers, etc.

Write for free copy of catalog No. 2023A

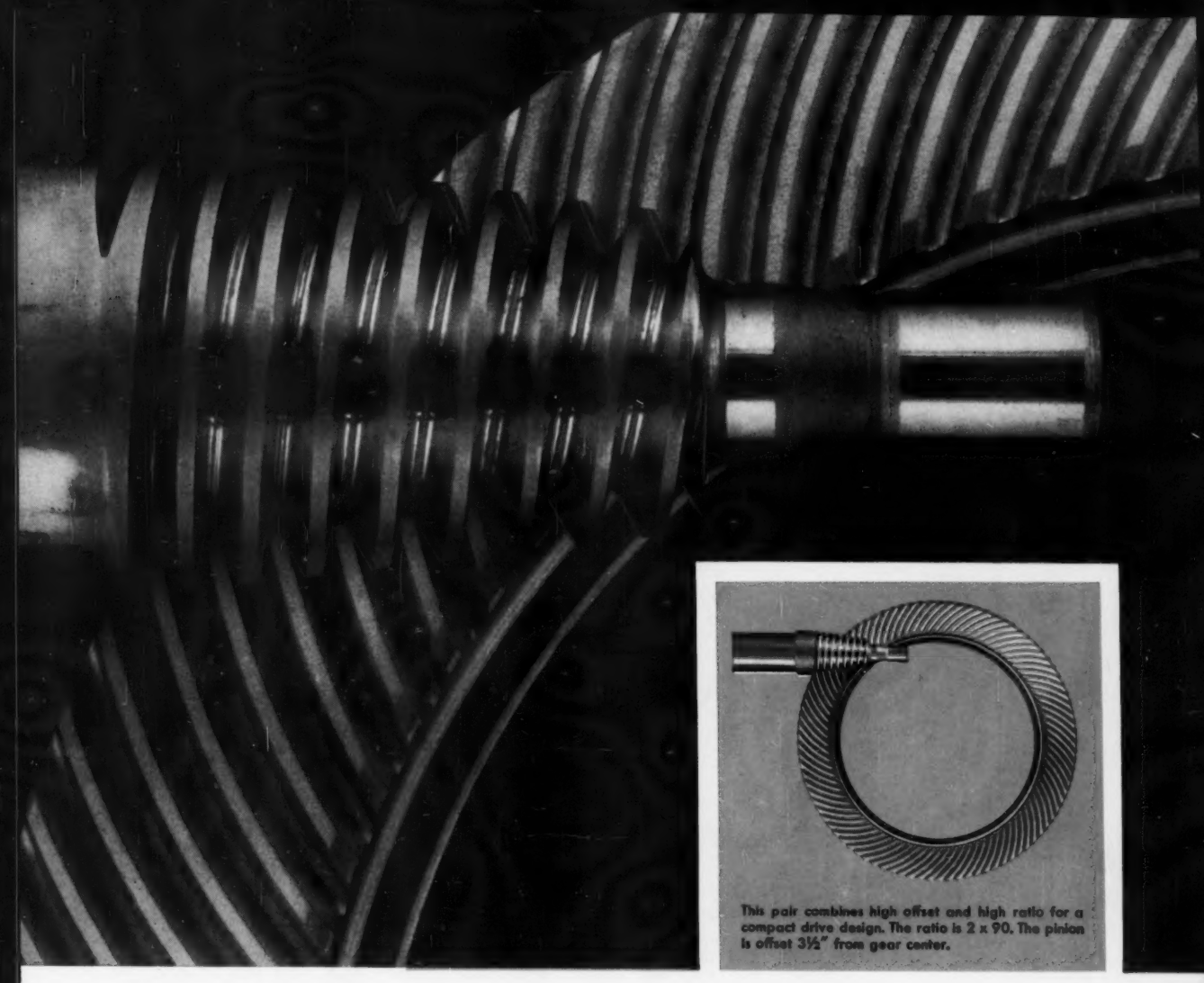
STEELWELD

Mechanical and Hydraulic

PRESS BRAKES

Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

THE CLEVELAND CRANE & ENGINEERING COMPANY • 5473 EAST 281st STREET • WICKLIFFE, OHIO



This pair combines high offset and high ratio for a compact drive design. The ratio is 2 x 90. The pinion is offset 3½" from gear center.

See how the teeth "wrap around" this high-reduction pinion

This is a high-ratio hypoid gear. In principle, it is not different from more conventional hypoids produced by the Gleason Works. *But . . .*

If you look closely at the pinion, you'll notice that the teeth tend to "wrap around" it. This design is extremely well suited for high reduction, strength and compact design.

The result is a conical (or sometimes cylindrical) pinion which permits *continuous tooth action—even with just one or two teeth!* Compared to corresponding bevel pinions, its diameter is greater for higher strength. An extended shank on cylindrical pinions makes *very rigid* straddle mountings practical.

You can design a *compact* unit, because high offset is possible! For high-offset *or* high-ratio pairs, the "wrap around" tooth design provides an extra measure of the smooth, quiet tooth action of hypoid gears.

High-ratio hypoids can be cut on the same Gleason equipment that is used on more familiar spiral bevel gears and hypoids. You can also use the same testers, quenching presses and other auxiliary Gleason equipment you're using now. Grinders are available for applications requiring precision finish.

High-ratio hypoids can be produced by the Gleason Works for ratios of 1:10 or 1:40 or even higher. They are finding a growing number of applications in such diverse fields as farm machinery, instrumentation and office equipment.

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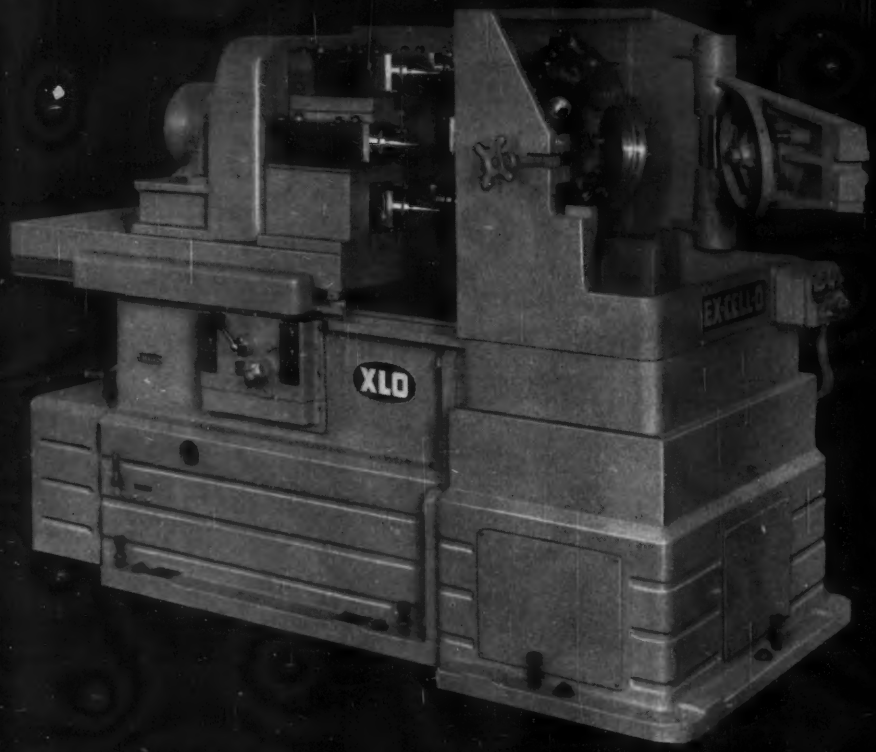

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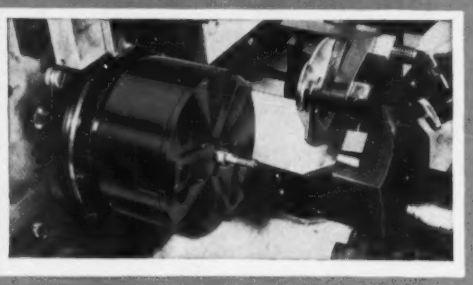

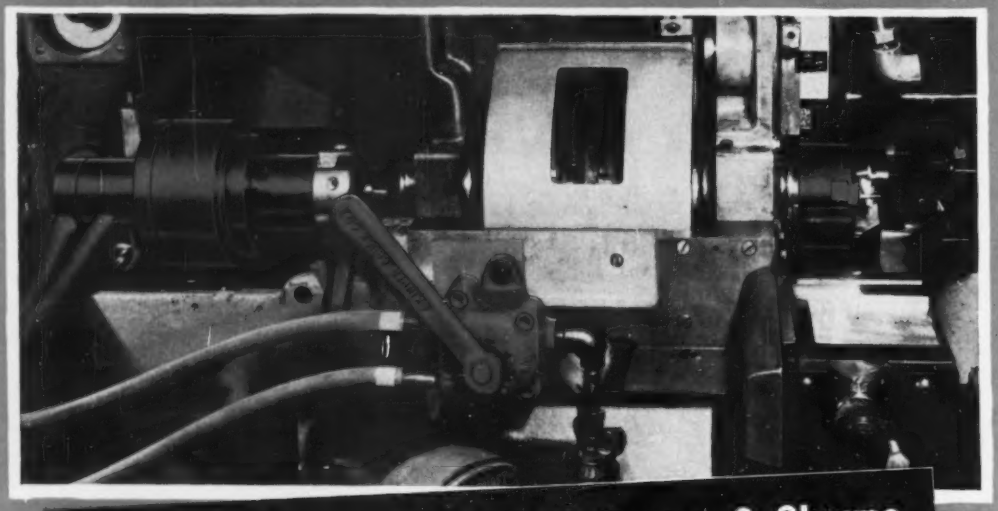

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- Industrial-Heating Industry Comes of Age
- Changing Defense Concept Releases Machines
- Navy Renewal Program
- Machine Tool "Trade-Ins" Proposed
- Washington Briefs

Keeping up with Washington

Loring F. Overman

PRODUCERS of industrial-heating equipment are receiving favorable attention from official Washington because the jet-inspired need for heat-resistant substances has made industrial heating of great importance to the Defense Department and to defense-supporting industries. Washington needs to know more about the industrial-heating industry, its equipment, and its capabilities.

Toward this end, the Metalworking Equipment Division, Business and Defense Services Administration, has mailed questionnaires to some 300 producers of industrial-heating equipment. Replies were requested by June 15. The Division plans to compile the data within weeks and to give Washington its first comprehensive picture of a segment of the industry on which the missile age is becoming increasingly dependent.

The survey questionnaire, prepared under the direction of James H. Sands, adviser to the Director of the Metalworking Equipment Division, separated the industry into eleven well-defined divisions, as follows:

Industrial-Heating Equipment Classified

1. Molten metal, melting, refining, and holding furnaces.
2. Hot-forming, forging, rolling, piercing, and extrude-heating equipment.
3. Heat processing and metal treatment, including brazing, sintering, etc.
4. Ovens, industrial process ovens (baking, drying, bonding, etc.).
5. Combustion equipment and other industrial-heating equipment.
6. Dielectric heaters.
7. Atmosphere gas generators, such as chemical, food processing, etc.
8. Solar industrial heating.
9. Atomic-energy industrial heating.
10. Miscellaneous industrial-heating equipment, such as washers, quenching apparatus, tank heaters, degreasers, and galvanizing settings.
11. Industrial-heating specialty equipment (infrared, quartz lamp, calciners, high-temperature and high-pressure air and gas pre-heaters).

Changing Defense Concept Releases Machine Tools

During the past eighteen months the changing pattern of defense production resulted in about 20,000 machine tools becoming excess to government needs. An important means of disposing of the surplus with a minimum of impact on the machine tool industry is the Government's program of donating the machines to educational institutions. This program retains the machine tools in the Nation's mobilization reserve, but at the same time makes them available to train young people with industrial skills. In 1959, according to Niels A. Olsen, Director of the Metalworking Equipment Division, Business and Defense Services Administration, the annual rate of disposal may reach 25,000.

Navy Renewal Program

The Navy's program to invest four million dollars in modernizing the shops of tenders and repair ships is one-fourth completed, the Bureau of Ships has reported. Surveys initiated in 1955 revealed that much of the equipment was of 1941 vintage, with some machine tools completely outmoded by new techniques and materials. In some instances, repair parts could not be provided by the original manufacturer.

"It was apparent," the Bureau reported, "that new tools would be more efficient and better adapted to new processes and materials. They would also reduce tool maintenance cost and result in better use of shop space."

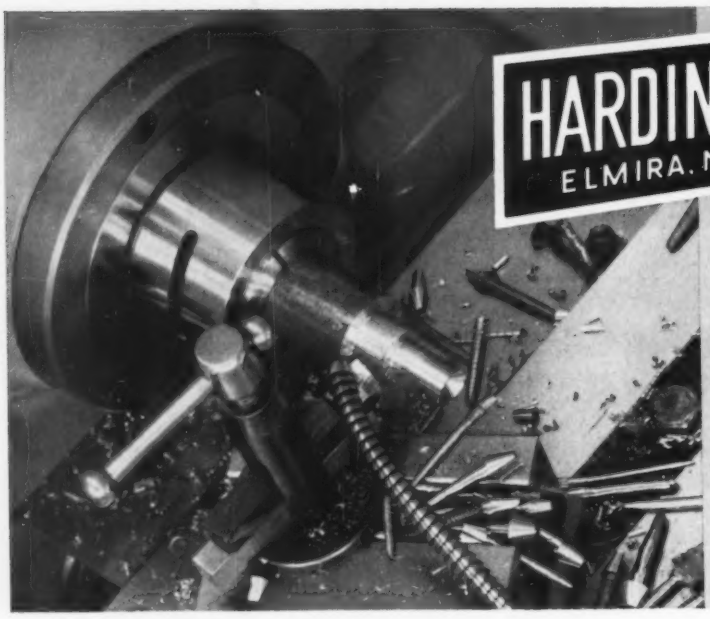
Machine Tool "Trade-Ins" Proposed

A Defense Department Instruction (No. 4215.17) establishes a new policy for replacing older machine tools by providing for their sale or trade-in on newer equipment. This does not apply to machine tools declared surplus. Instead, it is intended to make it easier to replace serviceable tools with more up-to-date models. Under the new policy, machine tools may be sold, exchanged, or traded in as part payment on the price of the replacement tool, according to DOD spokesmen.

Washington Briefs

Durables Rise. The Federal Reserve reports a moderate rise in business investment in producers' durable equipment and construction during the first quarter of 1959. At a forty-three billion dollar annual rate, the first-quarter figure was five billion dollars above the pre-recession peak and two billion dollars above last year's low.

Renegotiation. All concerns who have contract dealings with Government will be affected by plans of the House Ways and Means Committee to extend the Renegotiation Act for four years. The Committee's recommendation follows a Defense Department statement that, under current world conditions, defense expenditures will continue for the foreseeable future at unprecedented peacetime levels. The Committee also observed that the Defense Department conceded that contracting techniques of the procurement agencies are not adequate to protect, in all cases, against excessive profits.



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Machinery
JULY 1959

Even Explosive-Forming!

WHENEVER new products must be turned out on a quantity basis, engineering ingenuity is generally called upon to a considerable extent to devise new and efficient manufacturing processes. The more radical the product, the greater the variety of manufacturing problems that are imposed on engineering and production personnel.

Never were such premises more true than in the case of ballistic missiles and high-strength aircraft. The necessity of using the so-called "exotic" metals as structural materials capable of meeting unprecedented stresses and temperatures presented a considerable number of problems. These are being solved by the combined efforts of aircraft builders and equipment manufacturers unafraid to travel along unfamiliar technological paths.

Almost fantastic is the use of explosives for forming missile and aircraft parts from sheet metal—a process that has now been developed to the point where future possibilities seem practically unlimited. Parts up to 2 or 3 feet in diameter are being instantly formed into intricate configurations by detonating a comparatively small charge of explosive. Success in such operations has led to predictions that the process will eventually be applied to making components many times larger. This seems entirely feasible when it is recalled that a single pound of high explosive has an instant detonated force of one billion horsepower. Metal can be "blown" into the cavities of dies or form-blocks before it has the opportunity to tear apart.

The large size of missile parts and the components required in the construction of missile-launching equipment have also necessitated the construction of huge machine tools, welding equipment, metal-spinning machinery, and heat-treating furnaces, as well as small-size precision equipment for making the electronic devices that control the flight directions of missiles. In many cases the fabricating equipment is of unique design.

This, MACHINERY's Nineteenth Annual Aircraft and Missile Production Number, brings our readers up to date on the manufacturing methods currently used for building aircraft for modern high-speed transportation and missiles for national defense. Many of the novel ideas described are, of course, fully applicable in other fields of metalworking as well.

Charles O. Herb

EDITOR

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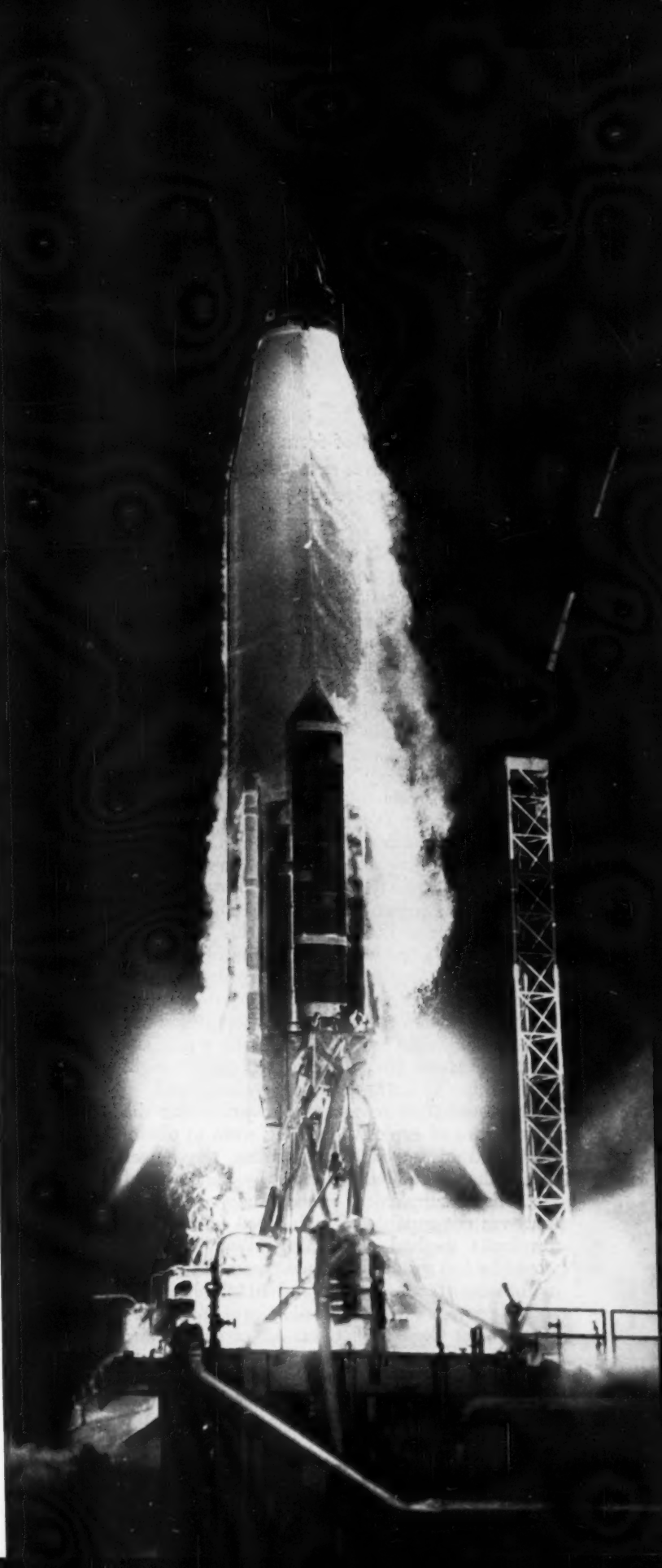


RYAN'S SPLIT-SECOND EXPLOSIVE FORMING

CHARLES O. HERB, Editor

A fantastic method of forming parts from all types of metal that is now beyond the experimental stage—explosives provide the energy

EXPLOSIVES have been used for several years in metalworking plants for performing comparatively simple operations such as dimpling, piercing, and riveting sheets in the fabrication of aircraft-frame components. Within the last year, however, a number of companies have been conducting research and experiments with explosives to solve the problem of forming high-strength, high-temperature metals that are specified today for rocket missiles and supersonic planes. Explosive or "high-energy" forming has now passed beyond the experimental stage at the Ryan Aeronautical Co., San Diego, Calif. As a result of the successful research carried out by the manufacturing-preplanning department of that concern, facilities have now been provided for carrying out explosive-forming on a truly production basis.

Inexpensive explosives, under this new practice, produce parts within a fraction of a second by the utilization of a sudden blast of tremendous power. There are certain preparatory details that must first be performed as will be here described, but the total time involved in making a part is a matter of about fifteen minutes as against eight to ten hours by methods previously employed.

Ryan's original reasons for investigating the possibilities of explosive-forming were to obtain a method of satisfactorily forming the newer metals that are difficult to shape by conventional methods; to supplement existing shop equipment that was not capable of high-speed forming; to develop a method of forming in which there would be less spring-back than commonly occurs in forming stainless steels and titanium alloys; and to provide low-cost forming equipment that would meet these objectives. All of these aims have been attained by explosive-forming. Metals such as Inconel, René 41, Hastelloy, 321 and 17-7 stainless steels, and titanium alloys present no forming problems under the new practice.

Explosive-forming as done at Ryan is basically simple. Use is made of a female die of epoxy resin, wood, or some other inexpensive material. The sheet to be formed is laid on or within the die and sealed to it in such a manner that a vacuum can be obtained between the work-blank and the die forming surfaces.

The work and die are then submerged in a tank of water. Air between the metal sheet and the die is then withdrawn. Inexpensive explosive of an amount predetermined as capable of doing the job is then suspended above or within the work. The explosive charge is contained in a polyester bag to protect it from the water.

With the work and die and the explosive charge in position, the explosive is detonated. The sudden blast of power instantly forces the metal sheet into all cavities of the die. The water acts to distribute the force of the explosion evenly despite irregular die contours in much the same way as rubber pads function in hydraulic-press operations. The explosive blast should cause the water to shoot into the air only a foot or two. In early experiments, when knowledge of desirable amounts of explosives was meager, "geysers" of 15 to 20 feet would be spurted upward.

It has been estimated that in explosive-forming the metal is moved into desired shapes at speeds from 200 to 500 feet per second. This speed is too fast to permit metal sheets to tear. Hemispherically bell-shaped, corrugated and deep-drawn parts have been produced with practically no spring-back or work-hardening, these characteristics being common in conventional forming of the "exotic" metals. Consequently, when formed by the better-known methods, hours of step-by-step forming, interspersed with heat-treatments, are necessary before the final shape is obtained. This is eliminated with explosive-forming.

The water tank or pit used in explosive-forming

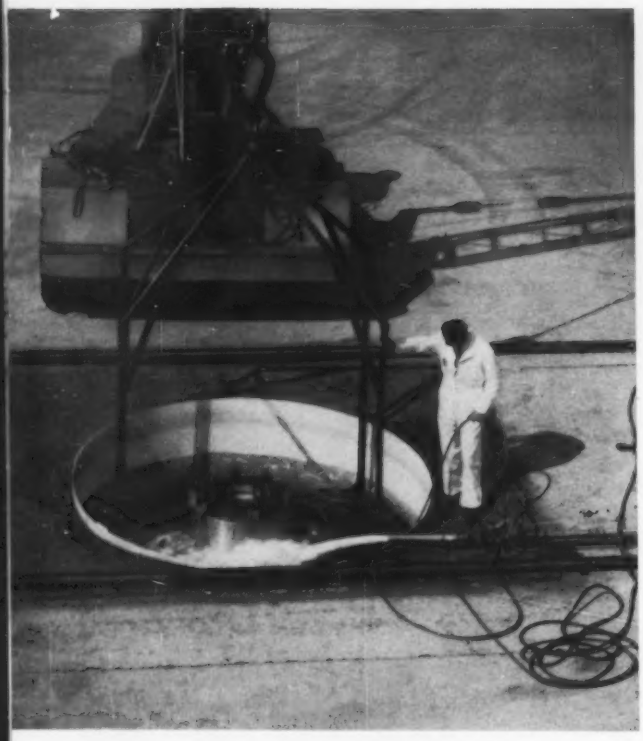


Fig. 1. Water pit in which the Ryan Aeronautical Co. performs explosive-forming operations on sheet metal, especially of the "exotic" types.

is 10 feet in diameter by 8 feet deep and is embedded in concrete as seen in Fig. 1. The heading illustration shows an "explosion" actually taking place. A concrete-covered area 108 by 78 feet provides space for preparing work for forming and for removing finished work from dies. The facilities include an air-operated, 5-ton hoist on a portable crane, a vacuum pump, a separate small building that serves as a storage for explosives, and air, water, and electrical lines.

Reference has already been made to the necessity of providing an air seal between the work and the die. This is accomplished by fastening a small-diameter length of neoprene or rubber around the edges of the work and the adjacent die surface by applying adhesive. Through a hole that passes from an outer wall of the die to the cavity, air can be withdrawn by the vacuum pump. A vacuum of less than one-tenth of a millimeter of mercury is generally obtained.

Several types of explosives have been used, including dynamite, PETN, teryl, and cyclonite. They are selected on the bases of thermal sensitivity, mechanical or shock intensity, ease of initiation, power, and explosive heat. Metals ranging from 0.016 to 0.063 inch in thickness have thus far been formed.

Comparatively large sheets of metal have already been explosive-formed, which indicates that the process will be applicable to parts quite a few feet in diameter. Fig. 2, for example, shows an Inconel sheet about 5 1/2 feet square and 0.025 inch thick. This part, with its configurations and beads, was formed with one explosion. Several bags of explosive were used, however,

Fig. 2. Large Inconel sheet formed instantly by the discharge of several bags of explosive while immersed in the pit of water in Fig. 1.

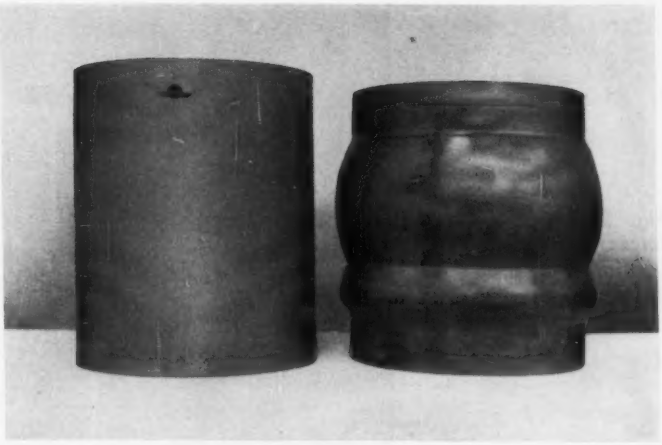


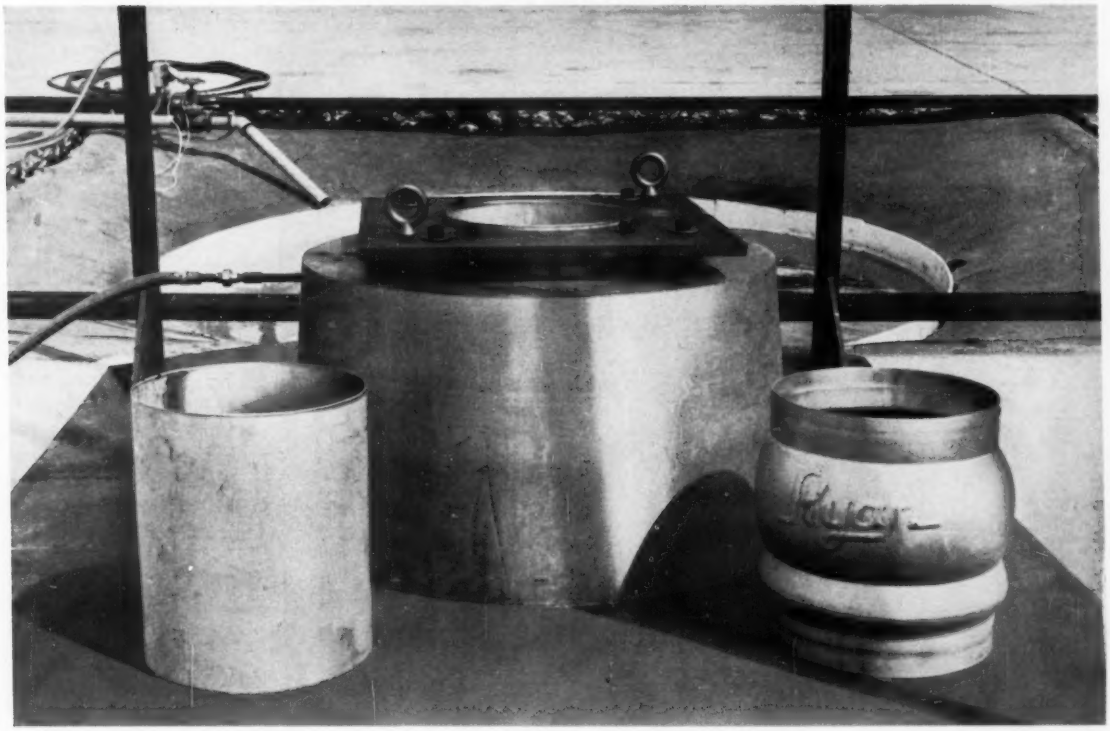
Fig. 3. The barrel-shaped part at the right is produced by explosive-forming from cylinders of stainless steel and Haynes 25 alloy, such as seen at the left.

because of the dimensions of the sheet. They were spaced opposite the deep hollows and at two heights with respect to the sheet. The regular Kirksite die formerly used under a drop-hammer was also employed for the explosive-forming operation, this die being faced with epoxy resin.

In the case of parts circular in shape and with a curved or irregular contour, it is necessary to use split dies in order to be able to remove the formed part from the die. This is true of the barrel-shaped part illustrated in Fig. 3, which has been produced both from AISI-347 stainless steel and Haynes 25 alloy 0.063 inch thick. The part is formed from a seam-welded cylinder as seen at the left. When completed, the part is 15 inches high, 15 inches in maximum diameter, and 12 inches in diameter at the ends.

In explosive-forming this part, the word "Ryan" is embossed on one side as seen on the part at the right in Fig. 4. This gives an indication of the

Fig. 4. The split die which forms the part in Fig. 3 is assembled in a heavy ring of Kirksite and a steel plate with eyebolts that facilitate handling.



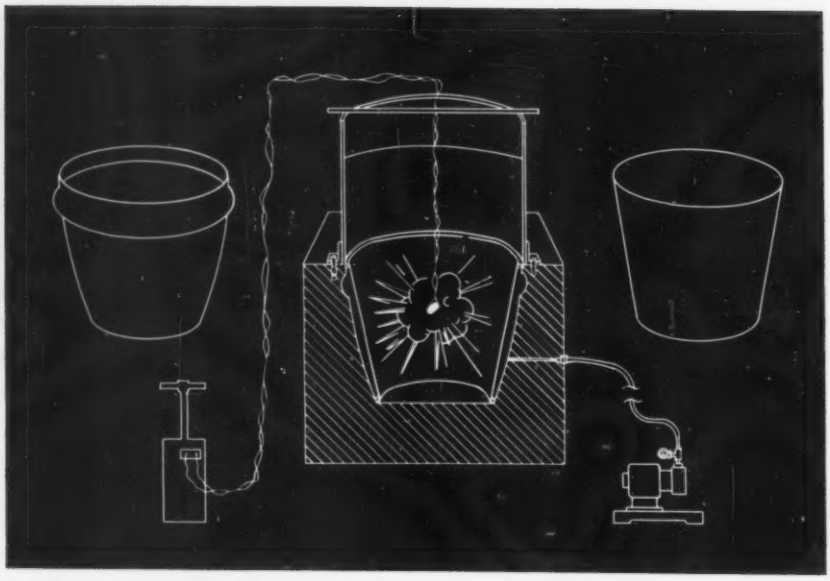


Fig. 5. The explosion forces the wall of the part firmly against the die cavity, causing rim to bulge.

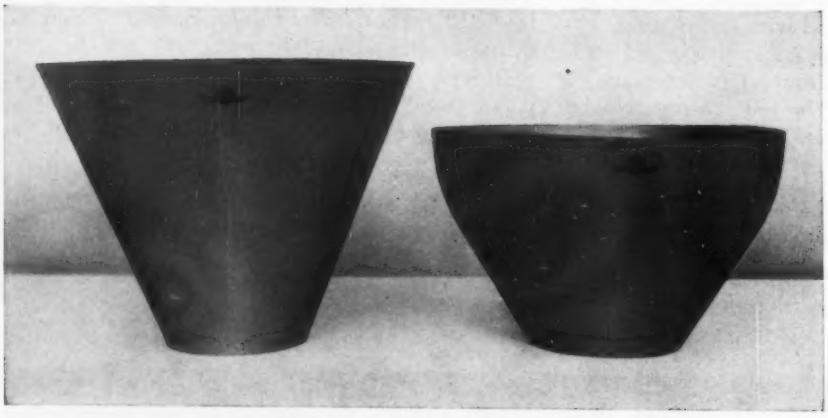


Fig. 6. Dome-shaped part at right formed from a cone segment of stainless steel and also of Rene 41, an alloy containing about 50 per cent nickel.

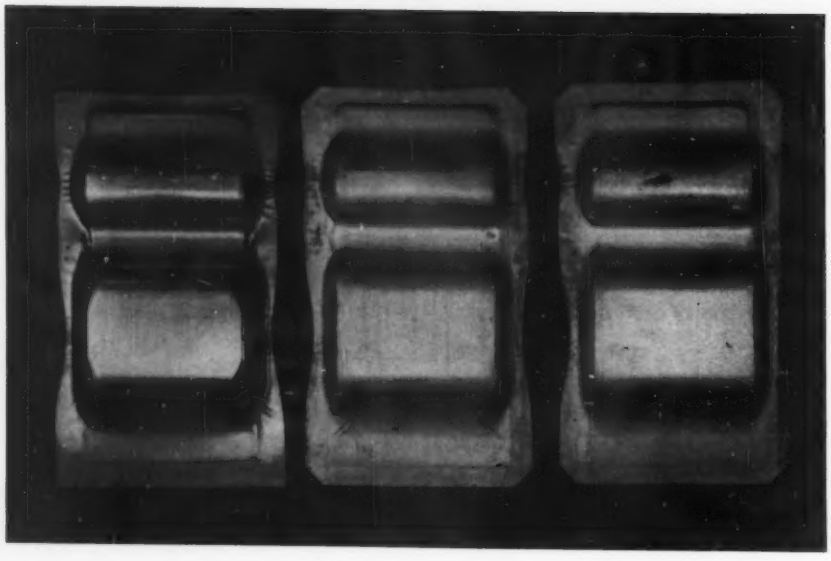


Fig. 7. In forming each of these two-cavity parts from Hastelloy X, two bags of explosive are provided, one for each of the cavities.

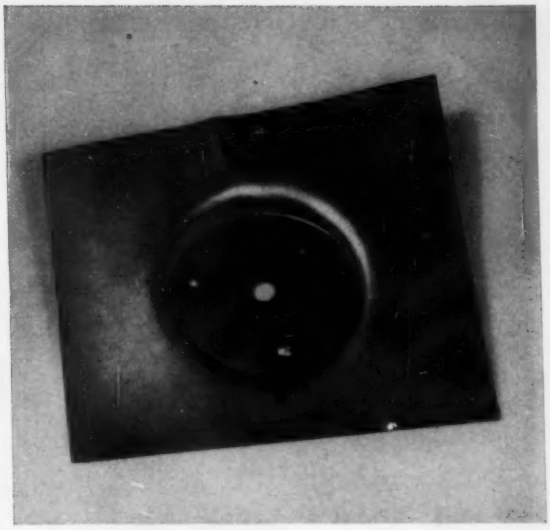
intricacy of detail that can be obtained by the process. Fig. 4 shows the split die assembled in a Kirksite cylinder, with a steel plate attached to the top of the die for convenient immersing into the water tank. Fig. 5 illustrates diagrammatically what happens when the explosive is detonated.

At the right in Fig. 6 is shown the part on which explosive-forming experiments were first conducted by Ryan. It measures 15 inches in diameter at the top, 5 1/2 inches in diameter at the bottom, and is 10 inches high. It has been successfully formed from AISI-321 stainless steel 0.037 inch thick and from René 41 alloy, 0.020 inch in thickness. The latter is an alloy containing about 50 per cent nickel.

When this part was formed by conventional methods about ten hours were consumed in forming, annealing, cleaning, and re-forming. It is now made within fifteen minutes, including the time required for setting up the die and removing the finished part.

Three pan-like parts with two depressions each, shown in Fig. 7, were formed from 0.063 inch thick Hastelloy X. The over-all dimensions are 40 by 16 inches. The one cavity is 5 inches wide and the other, 10 inches in width. Two charges of explosive were used in forming each part and only a female die member was employed.

Explosives have also been applied by Ryan in blanking operations on some of the "exotic" metals. In Fig. 8, for example, is illustrated a sheet of 0.032-inch-thick Ti-72-A titanium and 0.063-inch-thick AISI-321 stainless steel. A hole



3 1/2 inches in diameter was "blasted" through the sheet by merely attaching a thin "punch" to the sheet in the desired location.

Blanking possibilities are demonstrated more conclusively by Fig. 9 which shows a large sheet of Hastelloy X 0.063 inch thick. The various holes were produced by the punches that surround the part with a single explosion. The sheet is about 3 feet in diameter.

In explosive-forming there is some thinning of the metal which is proportionate with the depth of draw. There is also some work-hardening. Both of these characteristics, however, are less pronounced than with conventional forming.

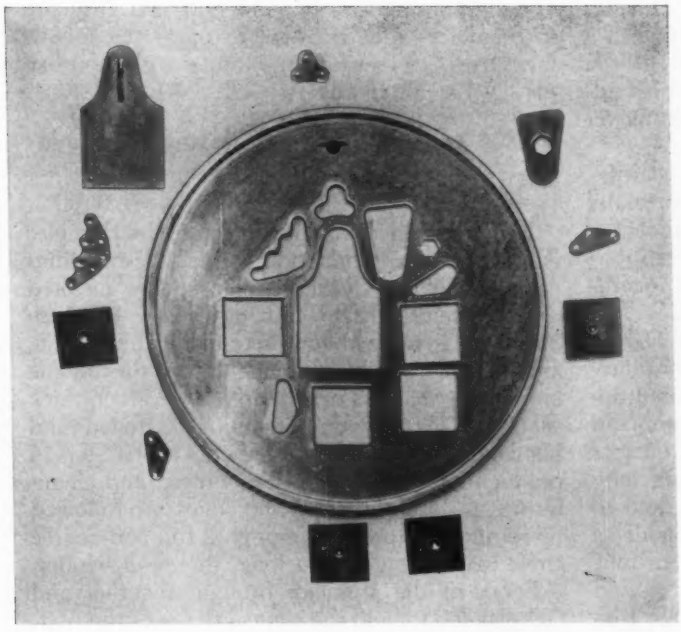
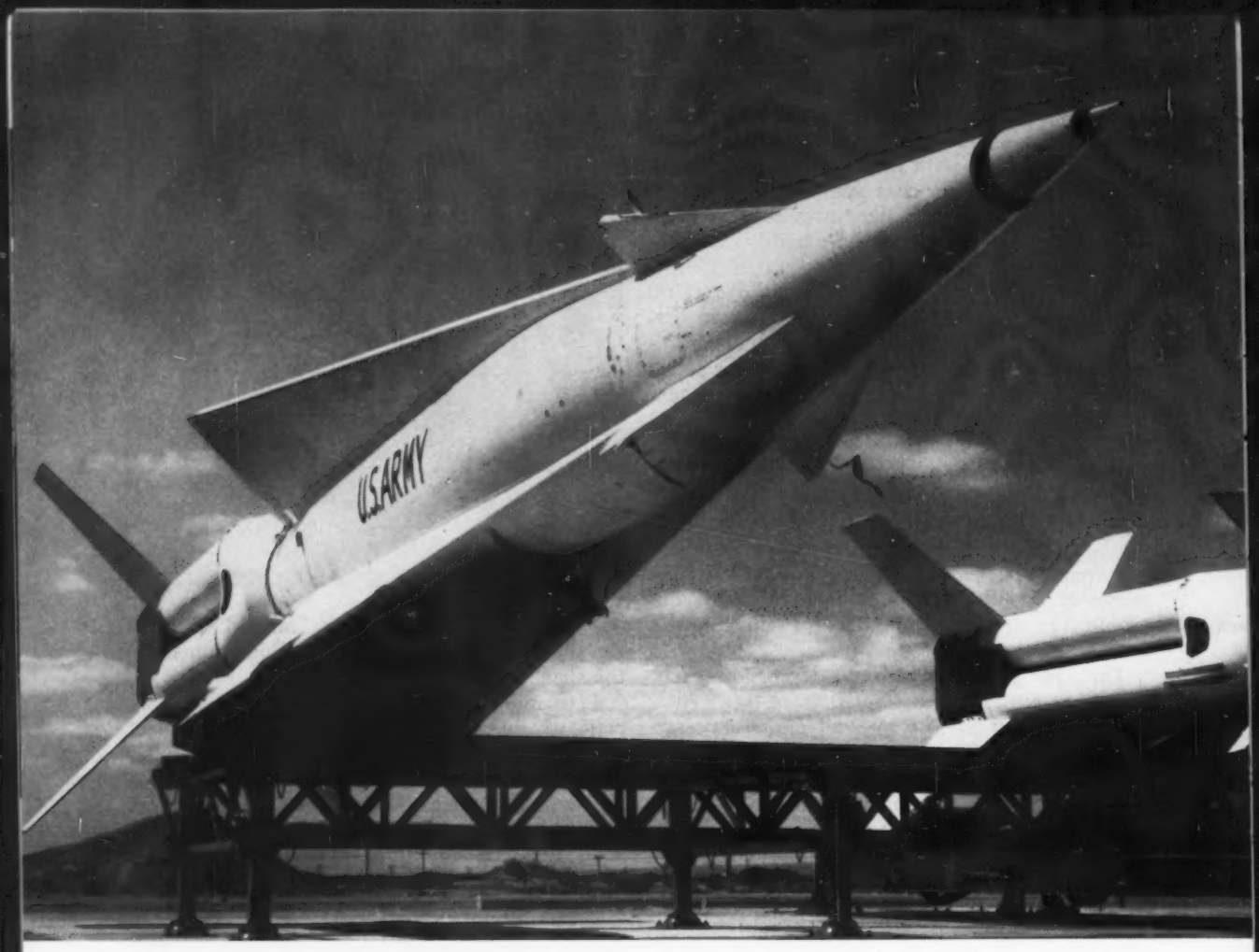


Fig. 8. (Above) Explosives are also used for blanking operations on hard-to-work alloys. This illustration shows a titanium sheet with a 3 1/2-inch hole "blasted" through it.

Fig. 9. (Left) Large sheet of Hastelloy X through which a variety of holes was pierced by blowing the surrounding "punches" through the sheet.



HOME of the Nike-Hercules surface-to-air missile is the Charlotte Division of the Douglas Aircraft Co., Inc., in North Carolina. Here, in a plant that remembers the manufacture of the Model T Ford, this country's latest and most advanced air-defense guided missile is coming off the assembly line in a steady flow.

Nike missiles are an integral part of a complex spotting and guidance system that electronically picks up and tracks its target, then launches a rocket at the proper instant to achieve an interception. The system functions effectively regardless of weather conditions or visibility.

Second member of the Nike family, the Hercules, has greater speed, range, and maneuverability than its predecessor, the Ajax, and has been operational since July, 1958. It is a radar-command missile carrying either a conventional or nuclear warhead and is capable of destroying any manned aircraft or cruise type missile known today. When launched, the two-stage missile is brought to supersonic speed by a cluster of four solid-propellant boosters. Following this period of initial thrust, the booster section drops free and a solid-fuel sustainer motor takes over. The Hercules proper is 27 feet in length and 31 inches in diameter—with boosters in place the missile measures 41.5 feet in length and weighs approximately 10,000 pounds.

Aft Nose Cone Rolled, Welded, and Planished

Long past the development stage, the Hercules is in continuous production with all six buildings constituting the Charlotte plant being devoted almost exclusively to this task. One of these buildings is utilized for sheet-metal fabrication, and it is here that components for the missile body take shape. For example, 0.125-inch-thick sheets of 6061-O aluminum are flattened and blanked to a trapezoidal shape as a first step in producing aft nose cones. Deburring, and chamfering and preforming of the edges are followed by forming of the skin through a full 360-degree circle in two stages on a long, three-roll bender.

Edges of the joint are brought together and tack-welded to hold the conical shape of the part.

NIKE-HERCULES IN STAR ROLE AT DOUGLAS

RAYMOND H. SPIOTTA
Associate Editor

Capable of carrying a nuclear warhead that can destroy an entire aerial fleet with a single blast, the Nike-Hercules is in initial deployment around New York, Philadelphia, Chicago, and Washington-Baltimore areas. It is the product of an Army-Industry team that includes Army Ordnance, Western Electric Co., Inc., Bell Telephone Laboratories, and Douglas Aircraft Co., Inc.

The skin, which measures approximately 6 1/2 feet long at this point, is slipped over the arbor of a Pandjiris welding machine, Fig. 1, and is clamped in place with the joint-line up. A Mig (metal inert gas) arc weld is laid down by a Miller welding head that travels along a horizontal, double-track support.

Following continuous welding, the seam is smoothed and work hardened by a planishing operation, Fig. 2. The part illustrated is not a nose cone, but is the skin for the warhead section of the missile. (Details of the operation, however, remain the same.) The skin is placed on a long horn of this Pandjiris machine with the joint facing upward. Planishing is effected as the weld seam passes beneath a power-driven roller having a very smooth working surface.

Bulge-Forming Imparts Final Shape to Conical Skins

Nose skins, after rolling and welding, possess a true conical shape (straight-sided). This is not, however, the precise form needed to blend with the contour of the Hercules. What is required is an ogival curve similar to that used on other pointed projectiles.

Such a contour is forced into the nose skin by bulge-forming. In a preliminary step the weld seam is spot-ground by hand in two places—near the top, or large end, and near the bottom, or small end. It is these two areas that are contacted by O-ring seals during bulging.

The bulging die into which the work is lowered measures approximately 7 feet in length, with all but about 8 inches sunk below floor level as shown in Fig. 3. To give an idea of size, the work-piece at this stage of fabrication is 25 inches in diameter at its large end, tapering down to 7 1/2 inches in diameter at its small end.

When the aft nose cone is seated in the lower die, the male die member, Fig. 4, is swung into position above it, then lowered into place. (Two O-ring seals are visible.) Proper orientation is assured by three long locating rods extending downward from the flange. As the male member settles within the nose cone, six upright locking posts protruding from the flange of the lower die

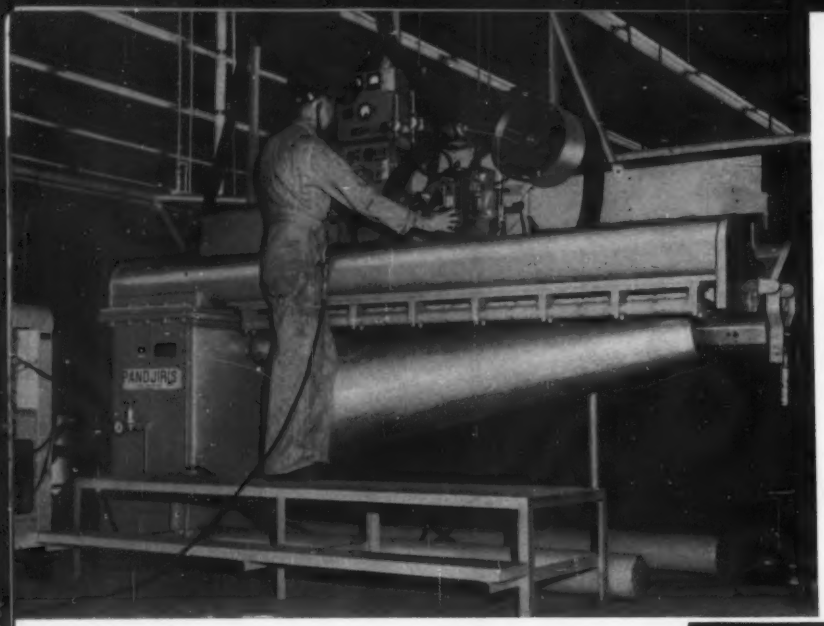


Fig. 1. (Left) Submerged-arc seam welding of skin for aft nose cone. The trapezoidal blank had first been rolled to shape, then tack-welded.

Fig. 2. (Below) Following continuous welding of this skin for a warhead section the seam is smoothed and work hardened by planishing. Weld seams on aft nose cones undergo the same operation.

(Fig. 3) pass through corresponding holes in the upper-die flange.

To lock the two members together, a ring on the upper flange is rotated. This carries six blocks with semicircular notches beneath retaining lugs at the ends of the locking posts. Each of these posts is attached to the piston of its own hydraulic cylinder and is pulled down against the blocks to secure the assembly.

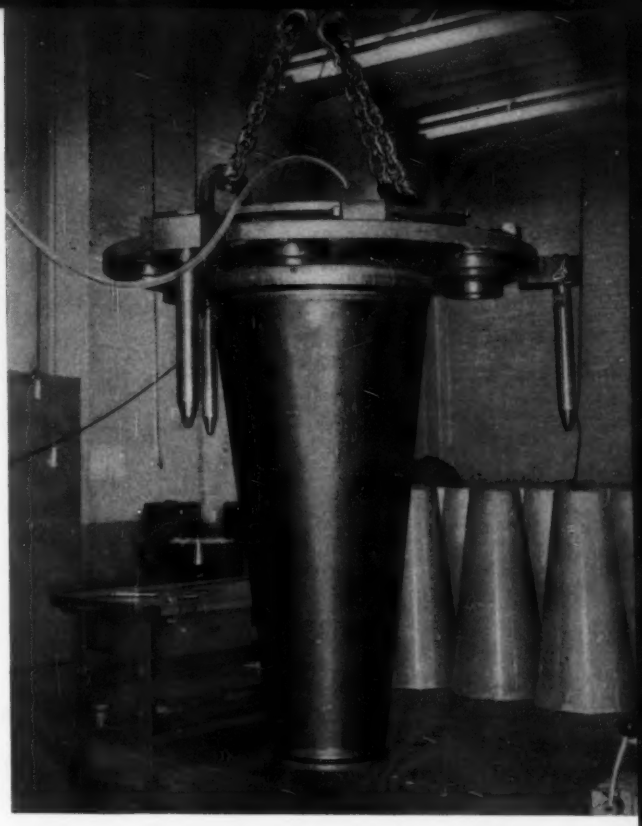
In Fig. 5 is a sectional diagram of the bulge-forming die after being locked up. The shape to be given the nose cone is provided on the outer die member only—the purpose of the inner die member being mainly to reduce the volume of air necessary for forming. There is about 1/2 inch of clearance between this member and the inside surface of the work-piece.

Air is piped to the center of the inner member and is then introduced to the sealed chamber between it and the nose cone through a pair of

Fig. 3. Bulging die for aft nose cone is sunk below the floor level for ease of work handling. In this operation the conical part is altered to an ogival contour.

opposed ports. Under a pressure of 600 psi the work-piece is bulged outward in all directions and assumes the shape of the female die. This takes place almost instantly. Pressure is released, the dies are unlocked, and the male die is raised from the cavity. The work is released from the die by air pressure that is directed against it at eighteen points. It can then be lifted clear and the next part inserted. There is almost no spring-back of the work when the forming pressure is released.

Another configuration of the missile which requires a nose cone tapering from approximately 3 1/2 inches in diameter to 14 inches in diameter over a 34-inch length is being manufactured by the Avco Mfg. Corporation through a power-spinning process using a Cincinnati Hydrospin machine. The part is first preformed from a round disc on a Cincinnati Hydroform machine, then passes through four subsequent power-spinning stages that carry it to final configuration. Douglas is also developing the techniques to make this part on a Lodge & Shipley Floturn machine. These last two processes result in an integrally formed bulkhead at the forward end which, on



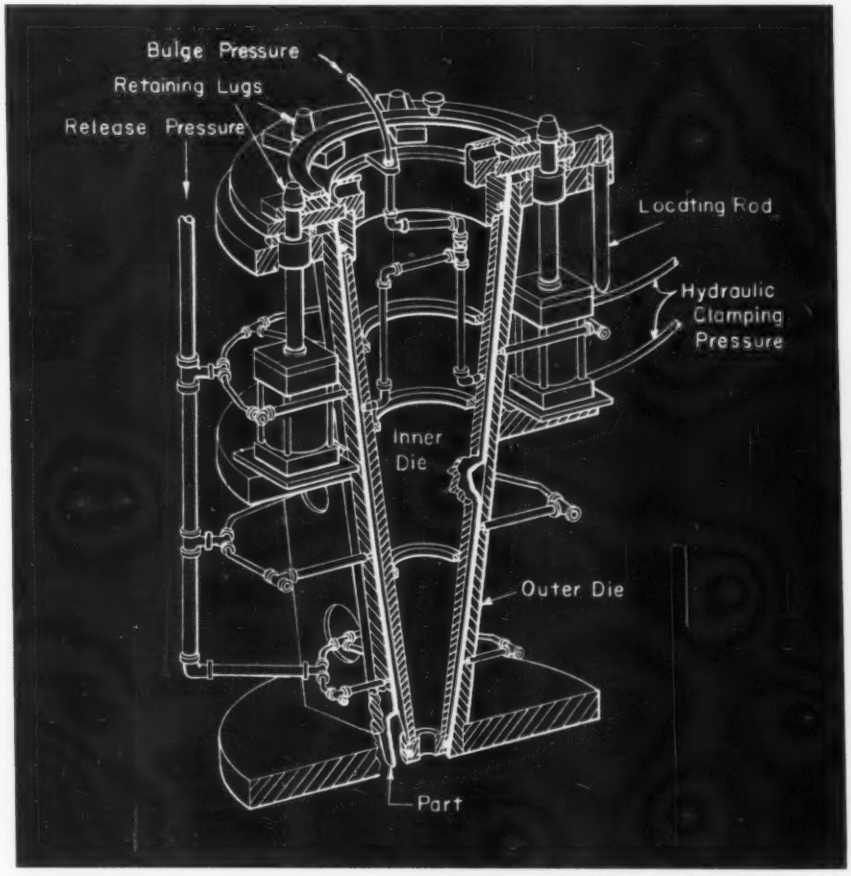


Fig. 4. (Above) Male die member used for bulging aft nose cones. Three long locating rods assure proper orientation of both die members.

Fig. 5. (Left) Section through the assembled bulge-forming die with work-piece in place. Air pressure at 600 psi forces nose cone against shaped outer die. When the inner die is removed, air pressure is applied around the outer die to break the work loose.

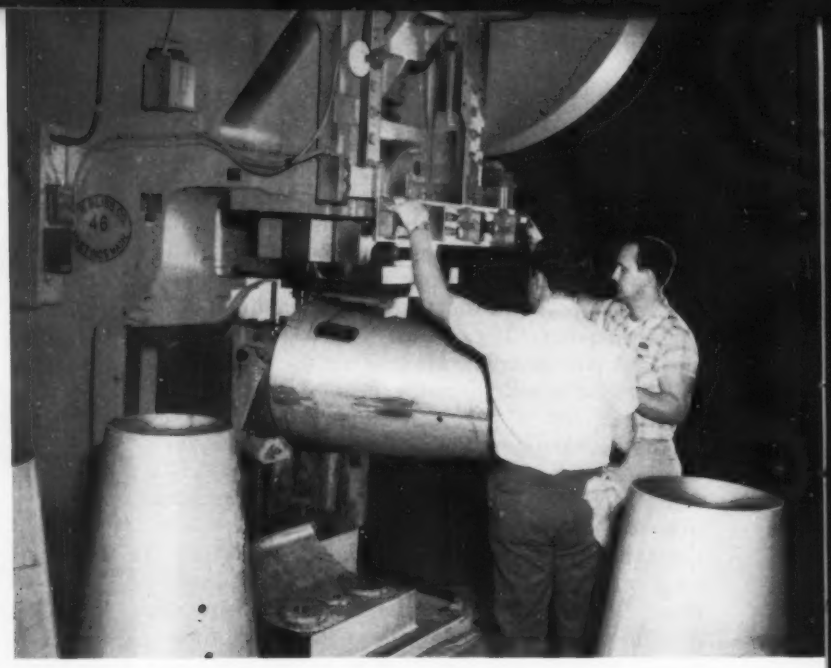


Fig. 6. Ten cutouts are blanked in the aft nose cone on this 150-ton horn press. Four tooling setups are required to complete each lot of parts.

the welded nose cone, requires an additional casting with a subsequent assembly operation.

Groups of holes are drilled through the formed nose cones in an upright jig that locates from the weld seam. This is followed by a series of blanking operations performed on the 150-ton, 15 1/2-inch-throat, Bliss horn press shown in Fig. 6. Here, in addition to ten cutouts at the ends of the parts, openings for three doors and four wave guides are punched.

Larger openings of the seventeen being punched in this group of operations are notched in steps because of their size. Location of the first hit for each opening is picked up from a pair of drilled holes. When the rectangular punch strikes the work-piece it, in turn, pierces two more locating holes alongside the opening. This provides accurate alignment for the subsequent hits necessary to complete the opening. Four tooling changes are needed for each lot of parts.

Aluminum Skins Undergo Interrupted Heat-Treatment

Although it was not mentioned, a heat-treating step preceded one of the described operations. The skins were brought from their annealed condition to an AQ condition prior to bulge-forming. To do this, the parts were subjected to the first phase of the hardening process—solution heat-treatment.

After being thoroughly cleaned, a batch of nose cones is loaded onto a rack and elevated into a Despatch drop-bottom furnace by a hy-

Fig. 7. Spars for booster fins are deep-hole drilled on this double-end machine. Two 27-inch-long drills feed through twenty lobes on this hinge-like part.

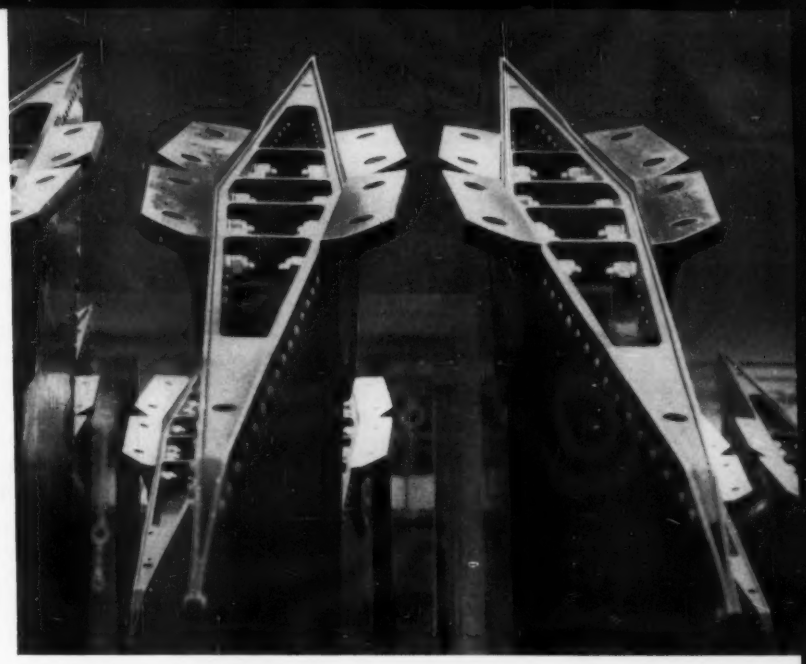


Fig. 8. (Right) Four forged aluminum attach angles are bolted and riveted to each booster fin for joining to the booster section. The mounting surfaces of these have already been machined and drilled.

Fig. 9. (Below) Carrier-mounted booster fin enters the first of two stations (left) of this special machine. An 8-inch-diameter end mill finishes the mounting faces of the attach angles shown in Fig. 8. Second station (right) drills and spotfaces the eight holes.

draulic lift. The temperature used for solution heat-treatment depends on the alloy, ranging from 970 to 1010 degrees F. To obtain the best results the temperature must be controlled within narrow limits (plus or minus 10 degrees F.). If the temperature is too low, maximum strength will not be obtained. If too high, there is danger of melting the lower-melting constituents in some alloys.

Soaking time is measured from the moment the coldest metal reaches the minimum limit of the desired temperature range. The soaking period varies with the alloy and the thickness of the work, ranging from forty to fifty-five minutes for the 0.125-inch-thick skins. It is so selected as to put substantially all of the soluble elements into solid solution. Prolonged heating of clad material will result in excessive diffusion of copper and other constituents into the protective layer, and may defeat its intended purpose.

At the end of the soaking period the furnace bottom moves laterally, allowing the rack and parts to drop into a cold-water quenching bath that is maintained at a maximum temperature of 90 degrees F. The volume of water is sufficiently great so as to preclude a temperature rise in excess of 20 degrees F. This drastic quench insures maximum resistance to corrosion.

When removed from the bath, the parts are in the AQ, or "as quenched," state. The designation applies to the relatively ductile condition existing immediately after solution heat-treatment. This condition may last for a few minutes to a few hours at room temperature, but can be preserved

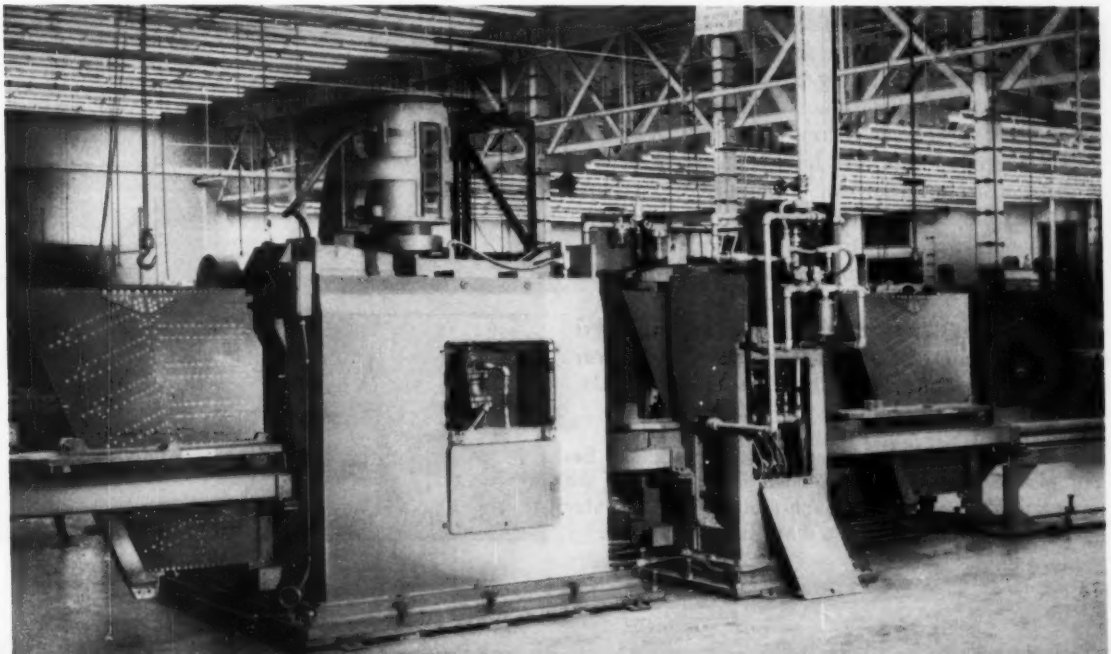


Fig. 10. Motor thrust frame of forged aluminum is being contour-machined on this heavy-duty lathe. The profile is controlled by an air-gage tracer unit.

for a reasonable length of time (several days) by refrigeration, which retards natural aging. Such treatment is accorded the nose cones.

At minus 32 degrees F. the beginning of the aging process is delayed several hours. From minus 50 to minus 100 degrees F. aging is retarded for an extended period of time. At Douglas, parts are maintained at 0 degrees F. or lower. It is in this AQ condition that they are bulged.

After the blanking operations have been completed (also in the ductile state), the parts are brought to the T6 condition. Aging, or precipitation hardening, is accomplished by low-temperature thermal treatment. Precipitation hardening produces a great increase in strength and hardness with a corresponding decrease in ductility. Nose skins are artificially aged in an Indoco furnace. They are elevated to a temperature of 340 to 360 degrees F. and are held there for a period of eight to nine hours. Air cooling at room temperature follows.

Booster Fins Require Some Machining

Four stubby, broad-surfaced fins are mounted on the extreme-rear end of the booster section that provides initial thrust to the Hercules. In cross-section they more closely resemble a stretched-out diamond than an airfoil shape.

Booster fins are constructed in two halves, each half forming one major surface, which are joined together in the main assembly area. To facilitate this assembly and to assure proper alignment, a forged aluminum spar is riveted along the longitudinal center line of each half. Before assembly, alternate rectangular cutouts are milled across a lengthwise rib on the spar sections to form, in effect, a hinge. Holes are drilled through the lobes so that, for initial joining of the fin sections, the spars on each half are aligned and a long pin is inserted.

An interesting step in manufacturing booster-fin spars is the deep-hole drilling of the lobes. This is done on the special company-designed machine shown in Fig. 7. Because the face of the first lobe is machined at an angle and would cause difficulty in starting the long tool, it is jig-drilled (oversize) using a hand-held Aro pneumatic drill.

The spar is seated in a fixture and is held in place by ten toggle clamps. A No. 11 (0.191 inch in diameter) drill, 27 inches in length, is driven by an air-motor at each end of the machine. Both work-heads are pneumatically driven as they converge on the spar to drill a total of twenty in-line lobes (ten by each drill). The drills are supported between holes by bushings clamped to pairs of replaceable carbide wear plates. These wear plates are attached to fixture lugs that nest

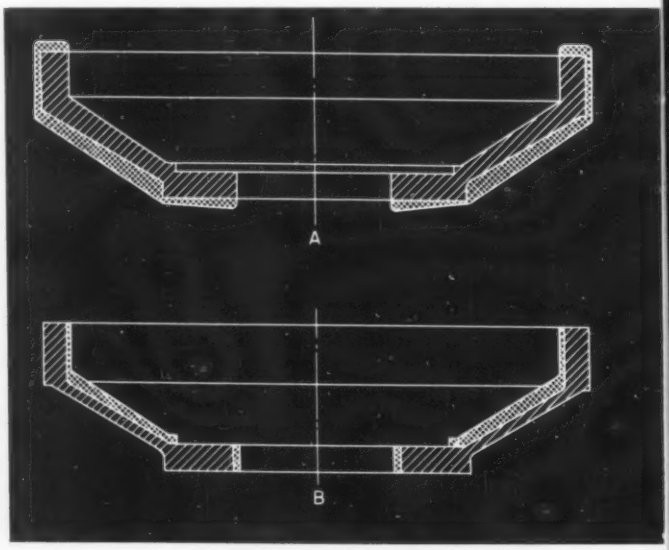


Fig. 11. Section of the motor thrust frame shown being machined in Fig. 10. Shaded areas indicate the material removed during rough-profiling of the outer surface, View A, and the inner surface, View B.

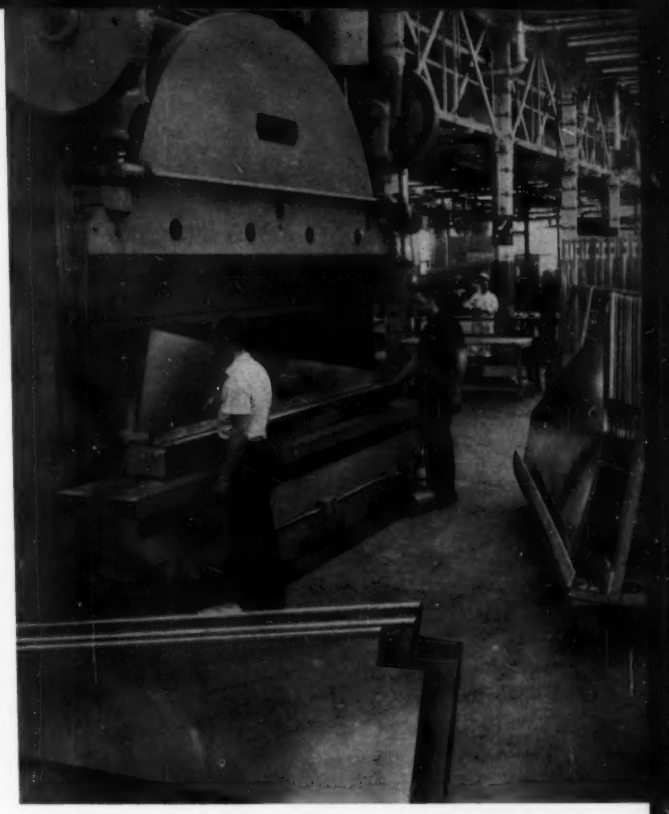


Fig. 12. Skins for the main fins receive final forming. To accommodate these large parts, the press brake was specially built with a shut height of 40 inches.

in the cutouts. This permits quick clearing of the tool, should it break.

Rapid advance while cutting air between the spar lobes, followed by a slower feed rate as the drill enters metal, is controlled by a cam-rod behind the machine. A feed rate of up to 7 1/2 ipm (inches per minute) is obtainable.

A unique feature of this machine is the method used to prevent tool damage while the operation is in progress. Should excessive drilling pressure build up, due to chip clogging or a dull tool, advance of the drill will be slowed down independently of the main work-carriage. The drill unit will then be moving backward with relation to the work-carriage (although still feeding forward, but at reduced speed) and so will strike a limit switch. This reverses the direction of carriage feed for a short distance, breaking up any chips that may have collected. If such cycling occurs too frequently, it is an indication that the drill is becoming dull.

Attach angles, which are, basically, forged aluminum angle brackets, are bolted and riveted to the booster fins during assembly. Four are required on each fin as can be seen in Fig. 8. It is these brackets that are used to join the fins to the booster section of the missile.

The mounting faces of the attach angles must be machined and drilled to match the contour of the booster body. Because of their position, it has proved simpler and more economical to perform these operations after, rather than before, assembly to the fins. (Those shown in the illustration have been completed.)

A company-designed, two-station machine utilizing a Pope spindle head, Fig. 9, was constructed for this purpose. Fins are nested, large end up, in trolley type carriers. Each fin first enters the main section of the machine (left in the illustration) where it is hydraulically lifted from the carrier and raised until it engages two locating pins. With the work thus locked in place, the spindle feeds horizontally across the faces of the four attach angles, finishing them in a single pass. Cutting is done by an 8-inch-diameter ball-end end mill having three inserted carbide teeth.

When the cut has been completed, the work is lowered into the carrier and is transported to the second station (right in the illustration). Once again the fin is lifted from the carrier, but this time it is positioned against the milled surfaces as well as by the two locating holes. Eight Keller pneumatic drill units—four on each side—feed up from beneath the attach angles to drill and spotface eight mounting holes. After the drills have retracted, the booster fin is returned to the carrier and exits from the machine.

Motor Thrust Frames are Aluminum Forgings

In the beginning of the Hercules program, thrust frames for the rocket sustainer motors were hogged from blanks cut from aluminum billets. When it is realized that these circular frames (shaped somewhat like a flared cup) are more than 31 inches in diameter and 3 1/2 inches in height, yet have a wall thickness ranging from approximately 3/16 to 7/16 inch, the amount of machining that was required and the quantity of chips removed become apparent.

Billets of aluminum have since been replaced by forgings of the same material. In a preliminary operation the inside diameter is partially bored on a Bullard vertical turret lathe to provide a chucking surface. The forgings are then brought to a Monarch heavy-duty Dyna-Shift lathe having a clearance diameter of 48 inches. Soft jaws carried on a six-jaw, self-centering chuck are used to grip the work-piece internally on the previously finished surface.

Control of this operation is by a swiveling air-gage tracer unit utilizing longitudinal template mounting, Fig. 10. The complete outer surface is rough-turned, including the face, step, taper, a second step, and the outside diameter. A single-

point carbide tool is used at a speed of 190 rpm and a feed rate of 0.018 ipr (inch per revolution). An allowance of 3/64 inch is left for finishing. The material removed during this operation is indicated by the shaded area in View A, Fig. 11.

A second Monarch lathe with a similar setup is employed to rough-profile the inner surfaces and the edge of the flange as indicated in View B. The motor thrust frame is returned to a Bullard vertical turret lathe on which the inside diameter, roughed in the first operation, is finished. Two more tracer-lathe steps are required to finish-profile the inner and outer surfaces at a speed of 220 rpm and a feed rate of 0.015 ipr. The use of both roughing and finishing steps is necessitated by strains that are relieved when the first cuts are taken, causing the parts to warp beyond roundness tolerances.

Forming the Main-Fin Skin

Skins for the four long, tapered main fins of the Hercules are formed from large sheets of 0.100-inch-thick Alclad 2024-T3 aluminum. Two triangular blanks are cut from each sheet measuring 64 by 190 inches. After blanking and piercing, two preliminary forming steps are performed.

Final forming is done on the Cincinnati press brake shown in Fig. 12. This is a special machine designed with a shut height of 40 inches, a stroke of 5 inches, and a bed length of 12 feet. A rack of notched and preformed blanks is at the right, and three completed skins can be seen in the foreground. A circular rod forms the contact edge of the unusually deep punch to provide the proper bend radius when the skins are folded.

Construction details of both the punch and the die members are presented in Fig. 13. The circular lower edge of the punch can be seen at *C* and is aligned with a pressure-pad *D* of the die assembly. Pneumatic die cushions support the pressure-pad.

Two edge-stops *E* serve to locate the back end of the work-piece. When the press brake is tripped, the punch contacts the blank centrally on its long axis and forces it and the pressure-pad

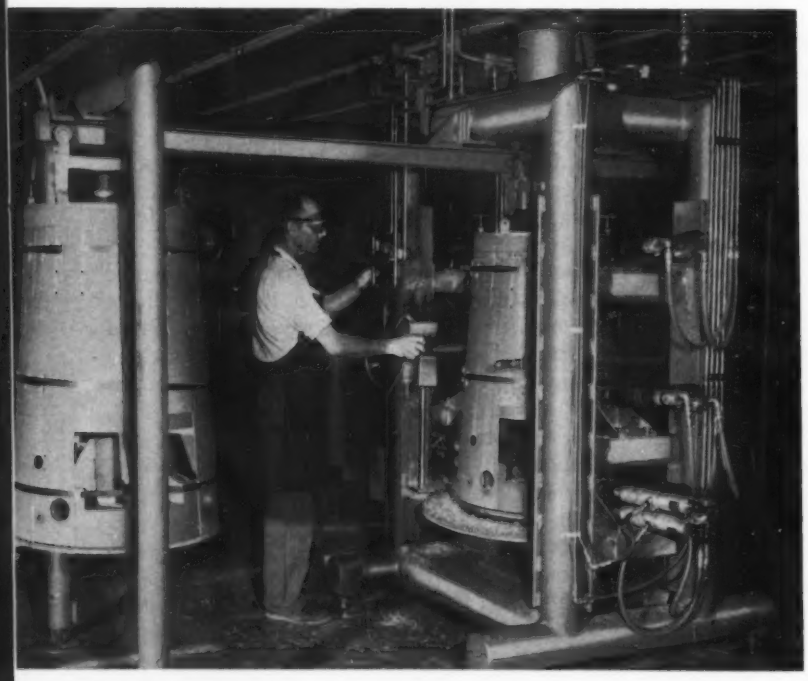


Fig. 13. (Above) Details of punch and die used to form the main-fin skins (Fig. 12). Circular edge of punch is at (C). Pressure-pad (D) is supported by pneumatic die cushions.

Fig. 14 (Left) Loading and drilling positioner used to drill skin for the control section. Two halves of skin are strapped together on positioning stand which is then seated on rotary table. Holes are automatically drilled in proper locations by sixteen air-motors as table indexes.

Fig. 15. Guidance and control units and other internal devices are being installed on the final assembly line. Preliminary assembly of main engine section is at left, while further assembly of this section, plus the nose section, is at right.

downward. As the aluminum sheet is pushed past a pair of curved-edged wiper blocks *F*, the two sides of the fin skin are folded upward against the punch body. At the bottom of the press stroke the lower surface of the pressure-pad strikes protrusions on two rocker blocks *G*, causing their upper edges to pivot inward and apply final pressure to the fin just above the formed edge of the punch. When the punch retracts, the die cushions force the pressure-pad up and lift the fin clear of the die.

Highlights of Some Final Production Steps

Flight of the Hercules is under the direct control of four magnesium elevons that are actuated by a compact hydraulic system. All components of this system are mounted on a doughnut-shaped casting that encircles the rocket sustainer motor at the extreme aft end of the missile.

Skin for the control section that houses these units is formed in two halves. In the assembly area these halves are joined with the internal bulkhead members and are drilled as a unit. To retain the loose parts in proper relation to one another, steel straps, such as those used on packing crates, are wrapped around the temporary assembly. Wedges of thin wood are spaced at intervals beneath each strap to prevent damage to the sheet metal.

Drilling is done on the efficient company-built loading and drilling positioner shown in Fig. 14. The control section is placed over a positioning stand which is then suspended from a monorail. The monorail passes through the work station (right) and extends an equal distance on the opposite side, thus providing two loading and unloading stations. A great saving is realized by this setup because it takes about the same length of time to take down a positioner, unload and reload it, and then rehang it on the rail as it does to actually drill it. While one assembly is being removed from the work station, another is being rolled into place.

In the work station the control section is seated on an indexing table. Spaced at appropriate levels are sixteen Keller pneumatic drill units (eight on each side of the machine frame). The operator throws one lever to start the cycle—the rest is automatic. Although the table indexes from one position to the next, holes are not required at each location. A system of index-pins beneath the table performs the function of selecting the individual drills to be actuated at each position of the work.

In Fig. 15 can be seen a section of the main assembly line. It is laid out in the shape of a hairpin with the main engine section being assembled along the leg at the left. Nose sections enter the line at the sharp bend and travel with the main engine sections along the leg at the right.

The gap seen behind the nose section is to be occupied by the warhead. It is not joined to the rest of the missile body but is packaged separately and shipped to an arsenal for loading, from there to be shipped to the launching sites for final assembly and arming. The Hercules is broken down into several other packages for shipment to these sites.

NORAIR HEATS WORK WITHIN SECONDS FOR

Radiant heaters with infra-red quartz lamps almost instantly raise the temperature of titanium-alloy sheets and other metals to hot-working levels while they lie on the forming die. Hours of time are saved—accurate parts are obtained without requiring subsequent operations

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PRESENT-DAY OPERATIONS in aircraft and missile manufacturing plants necessitate the forming of so-called "exotic" metals with the material heated to high temperatures. This is true of titanium alloys, pure molybdenum, magnesium, and precipitation-hardened stainless steel.

In forming titanium alloys, for example, it has been a common practice to heat the sheets and dies to 1100 degrees F. for the operation, this being generally considered the optimum temperature. Until recently, the practice in the Norair Division of Northrop Aircraft, Inc., Hawthorne, Calif., was to raise sheets of titanium alloy to this temperature in conventional furnaces located adjacent to the Cecostamp hammers that performed the forming operation. It took approximately 1 1/2 hours to heat a sheet and die up to 1/4 inch thick.

Even though the sheet was transferred from the furnace to the drop-hammer with utmost dispatch, the temperature of the blank had generally dropped to about 800 degrees F. before the forming operation could be performed. Under such a condition it was almost impossible to produce parts closely to specified configurations without subsequent reworking.

Such difficulties led to the conception by Norair's research and development engineers of a radically different method of heating sheets to be formed. Blanks are now raised to the required high temperature while actually positioned on the forming die and are formed within one second after they have been heated. A sheet at room temperature is heated to 1050 degrees F. within the almost unbelievable time of forty-seven seconds.

HIGH-TEMPERATURE FORMING

This new practice involves the use of portable radiant heaters that can be positioned close to the Cecostamp drop-hammers on the rear side as seen in Fig. 1. After the work sheet has been laid on the die, as shown, the hammer operator moves a handle on the front of the machine. This causes an air-powered mechanism on the radiant heater to quickly advance the heating unit into position over the work as seen in Fig. 2. Its battery of heat-producing lamps is turned on automatically at the end of this forward movement.

When the work-blank has attained the desired temperature, the operator again moves the machine handle, which causes the hammer to raise its rubber cage to the topmost position, and the radiant-heating unit to recede into the portable housing. The radiant lamps are turned off as the unit commences to move back. Within one second from the time that the operator manipulated the machine handle, the hammer drops and forms the part.

Radiant heaters for this work have been built in two sizes. The underside of the heating unit illustrated in Figs. 1 and 2 is shown in Fig. 3. This heater has fifty-four T-3 infra-red quartz lamps of 3800-watt, 575-volt rating. All lamps are used for the larger-sized sheets of work, but a battery of thirty lamps only can be turned on for smaller work. The tubes are 40 inches long.

With the fifty-four lamps turned on and operating at 3000 watts and 480 volts, the total electrical output is 162,000 watts. With thirty lamps in operation, it is 90,000 watts. This radiant unit has a heating area of 38 by 72 inches. In Fig. 3 the unit is seen at its highest position. It can be conveniently adjusted heightwise to suit the

Fig. 1. Magnesium blank on Kirksite die of Cecostamp drop-hammer ready to be heated to high temperature by radiant-heating unit at the rear of hammer.

Fig. 2. Radiant-heating unit advanced over the magnesium sheet on Cecostamp die being heated to forming temperature of 350 degrees F. within five seconds.

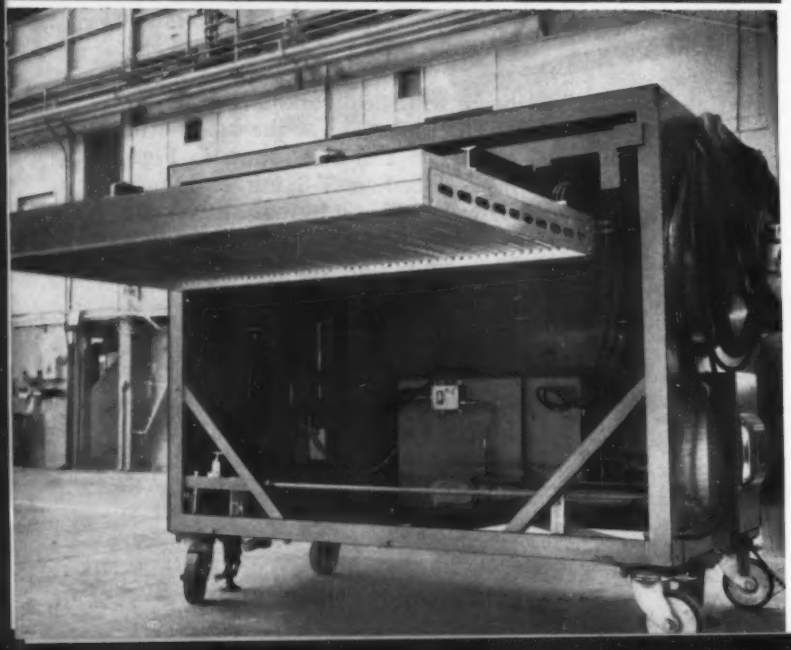


Fig. 3. Portable radiant heater with fifty-four infra-red quartz lamps that will heat the work-pieces to 1050 degrees F. within forty-seven seconds.

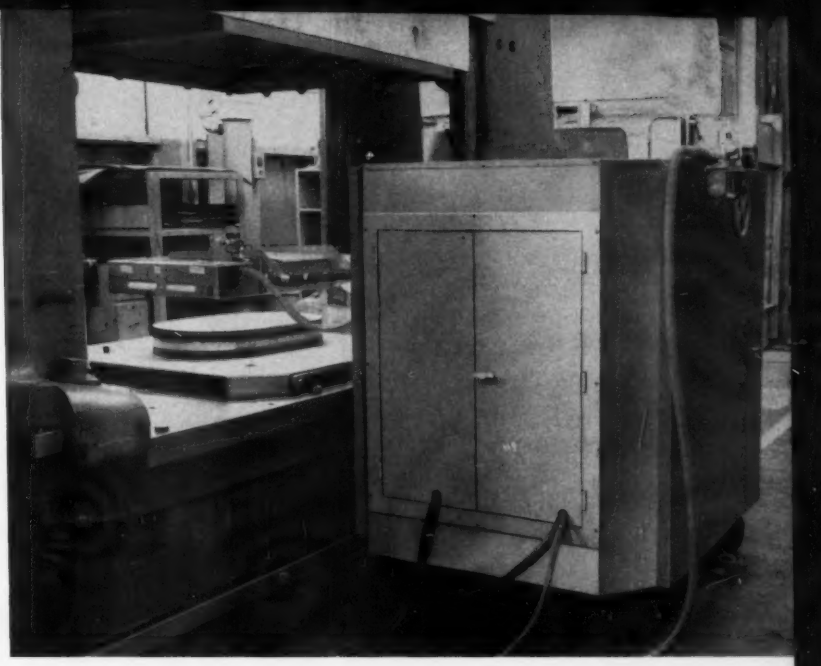


Fig. 4. Smaller-size, portable radiant heater equipped with eighteen infra-red quartz lamps that will heat sheets of metal to forming temperatures in a matter of seconds.

position of the work on the drop-hammer. It is customary to locate the unit 3 inches above the work being heated. Four motor-driven fans on top of the lamp carrier prevent excessive heating of the carrier itself.

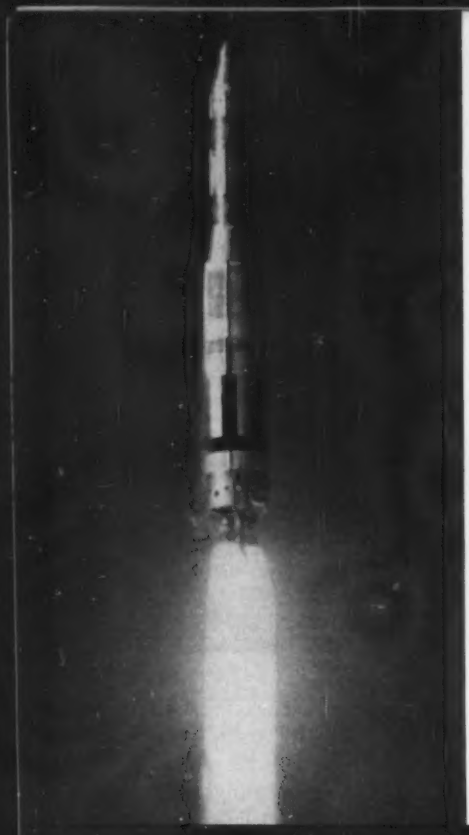
A smaller radiant-heating unit which has an effective heating area of 24 by 36 inches is seen in Fig. 4 at the rear of a drop-hammer with the lamp carrier extended over the hammer die and work. This unit has eighteen infra-red quartz lamps 28 inches in length. They draw a current of 30,000 watts. Ten lamps only may be used for small parts. As in the case of the larger heater, work-piece temperatures of 1050 degrees F. can be attained within forty-seven seconds.

Radiant heaters of the type here described can be applied to metal-to-metal die sets as well as in operations where rubber pads are used in conjunction with a metal bottom die. With metal-to-metal dies, toggles can be accurately formed on side surfaces of formed or drawn shapes without the necessity of resorting to subsequent hot-sizing operations.

Another particular advantage of radiant heating is derived in the case of magnesium sheets. Because there are certain time-temperature considerations with magneisum, that is, temperatures must be reached within a limited time, difficulties are often experienced in working magnesium. Such difficulties do not occur with radiant heating because the temperature can be raised as fast as 100 degrees per second.

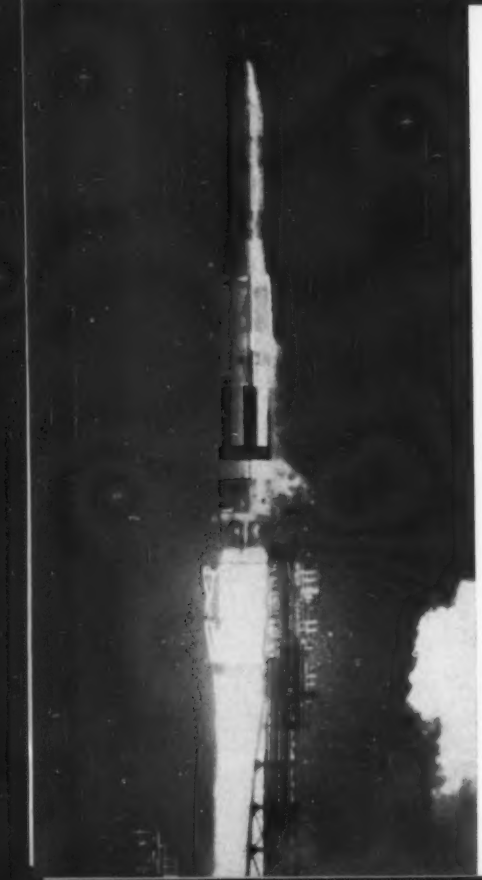
The dies, as well as the work, may have provision for preheating, as in the case of the one illustrated in Fig. 1. Unheated die members are also used in this high-temperature forming method. Sheets of material formed after radiant heating range from 0.006 to 0.350 inch in thickness.

Fig. 5. Forming operation completed on a magnesium sheet that was instantly preheated by the radiant heater seen at rear.



The manufacture of rocket engines requires the use of some unusual equipment as well as standard machines. This article describes Aerojet-General operations in producing solid-fuel engines. It supplements an article on liquid-fuel engines published last year.

BUILDING ROCKET ENGINES



CHARLES O. HERB, Editor

BOTH liquid-fuel and solid-fuel rocket engines for an extensive variety of ballistic missiles are products of the Sacramento, Calif., plant of the Aerojet-General Corporation. This plant now employs 12,600 persons, whereas in 1955 it had only 604 employes. These figures, together with the announcement that the payroll in 1959 will approximate seventy-five million dollars, indicate the impressive growth of an industry that is primarily concerned with national defense.

This article will deal only with manufacturing operations involved in producing components for solid-fuel engines, because machining methods on the same company's liquid-fuel products were described in an article published in MACHINERY, September, 1958. The importance of the solid-fuel division of the plant can be determined from the fact that in the first five years of its operation—from 1951 to 1956—this division manufactured 340,000 fully qualified units containing a total of 26,000,000 pounds of propellant.

Recently, the facilities of the solid-fuel plant have been utilized for turning out larger motors for tactical ordnance mis-

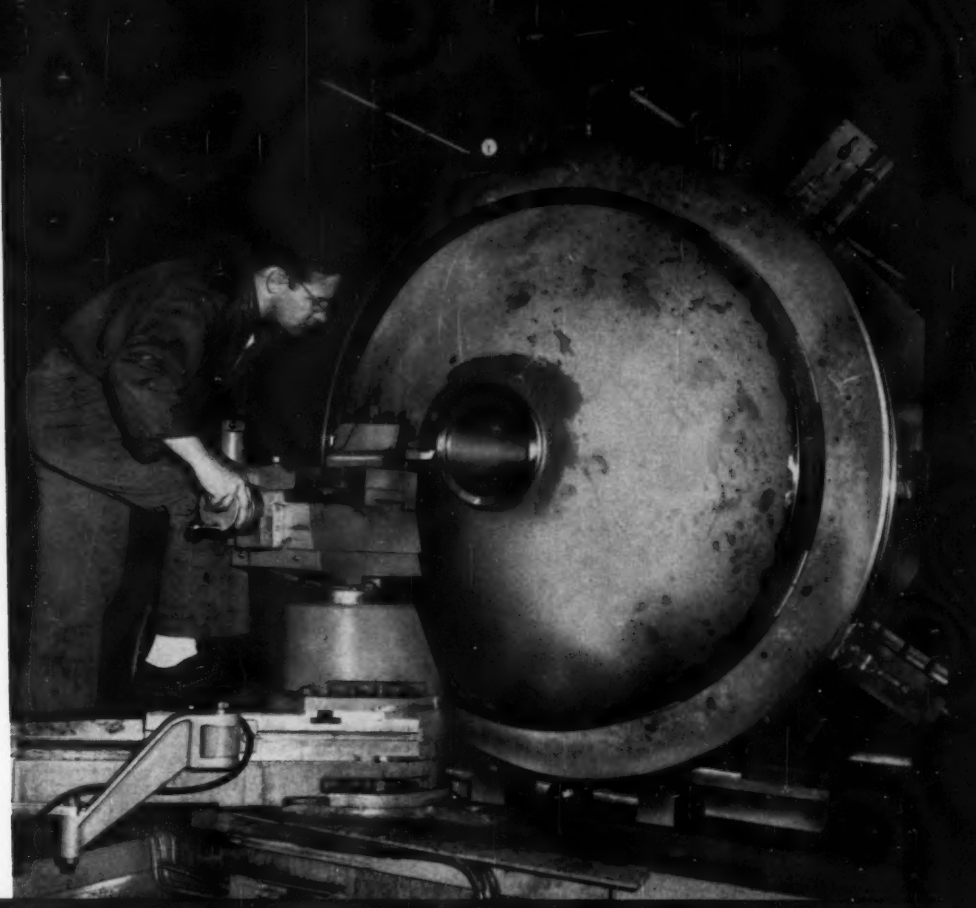


Fig. 1. Taking turning, boring, and facing cuts on the dome head for a missile on the specially designed lathe seen in Fig. 9.

FOR THE COUNTRY'S DEFENSE

siles than in past years. One production line turns out rocket motors intended for less than 4000 pounds of propellant while another line will produce motors for 40,000 pounds of propellant.

Solid propellants, incidentally, are a crystalline oxidizer dispersed in a matrix of plastic fuel. Oxidizers used are potassium perchlorate, ammonium perchlorate, ammonium nitrate, and various other combinations. Fuels are copolymers of polyester and styrene, copolymers of polyester-styrene-acrylates, polyurethanes, and oil-extended asphalt. The oxidizers are dried, blended, and ground to closely controlled particle sizes prior to mixing with the plastic fuels. After mixing, the slurry is cast into chambers or molds and cured. The grain can then be machined and selected burning surfaces be restricted. Thereafter, the motor is ready for assembly.

Several problems seem inherent in missile manufacture. One of them is to devise means of satisfactorily machining the so-called "exotic" metals such as tungsten alloys and pure molybdenum. At first it was necessary to resharpen tools several times before one cut could be completed across a single surface. Another problem has been the development of dependable methods of forming components from metal sheets within prescribed dimensions, and of welding such parts.

A general view of a Cincinnati Hydrospin applied for forming dome-shaped and other parts from discs and for lengthening large cylindrical chambers, and at the same time thinning their cross-section, is illustrated in Fig. 2. Discs handled by the machine may be completely flat blanks or pre-faced by a machine tool to obtain a cross-section of varying thickness around the configuration. Fig. 3 shows another view of the Hydrospin, looking toward the work and the forming rolls. In this particular setup, a dome-shaped part is being formed from a disc that had been previously faced to a thickness of 0.175 inch at the center and 0.350 inch around the periphery. When the part was taken from the Hydrospin the cross-section throughout was 0.170 inch thick.

The finished work-piece was approximately 54 inches in outside diameter, the same as the original blank. It was run at a speed of 150 rpm. The

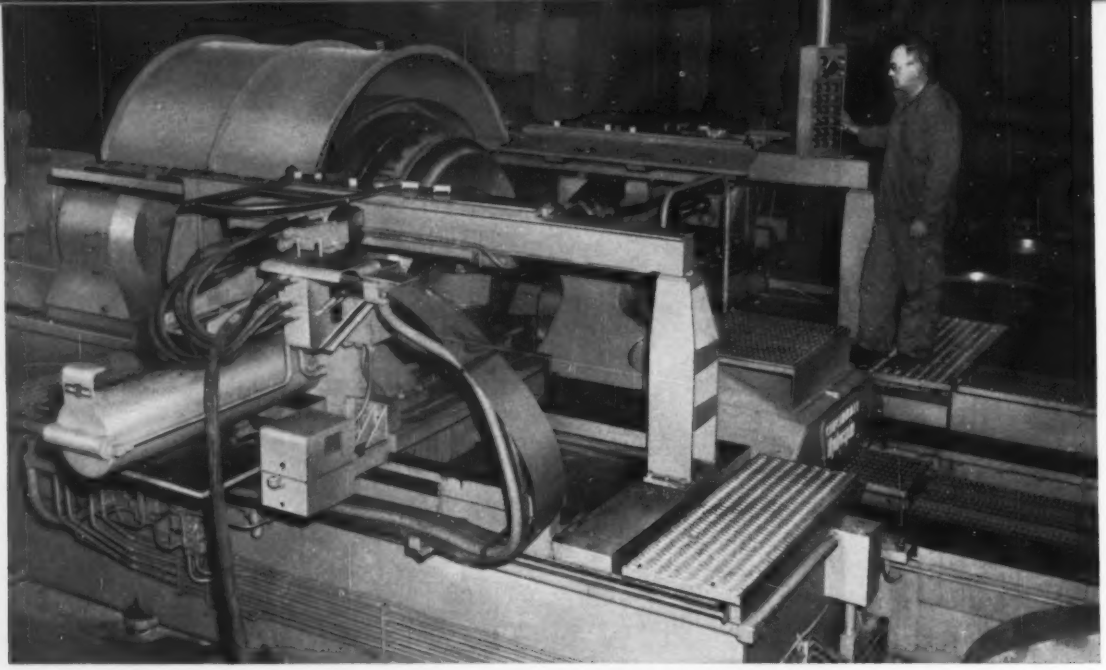


Fig. 2. Hydrospin forming machine employed for producing a variety of components from discs and for lengthening cylindrical parts.

two forming rollers revolve as driven by the work and each roller applies a force of 50,000 pounds. The rollers are mounted on slides that are adjusted to feed them at the most suitable angle for the particular job.

A tubular chamber handled by the Hydrospin is expanded longitudinally and the wall thickness is reduced. Another large tube 1/2 inch thick and 19 1/2 inches long at the start of an operation leaves the machine with a usable length of 50 inches. The wall thickness is 0.155 inch.

The large tubular and dome-shaped parts must be extremely close to specified size before delivery to welding machines or the assembly floor. Accurate diameters are assured by an Arrowsmith Hydra-Size which is applied to stretch the rim of a dome-shaped missile head. Parts are customarily stretched 0.270 inch.

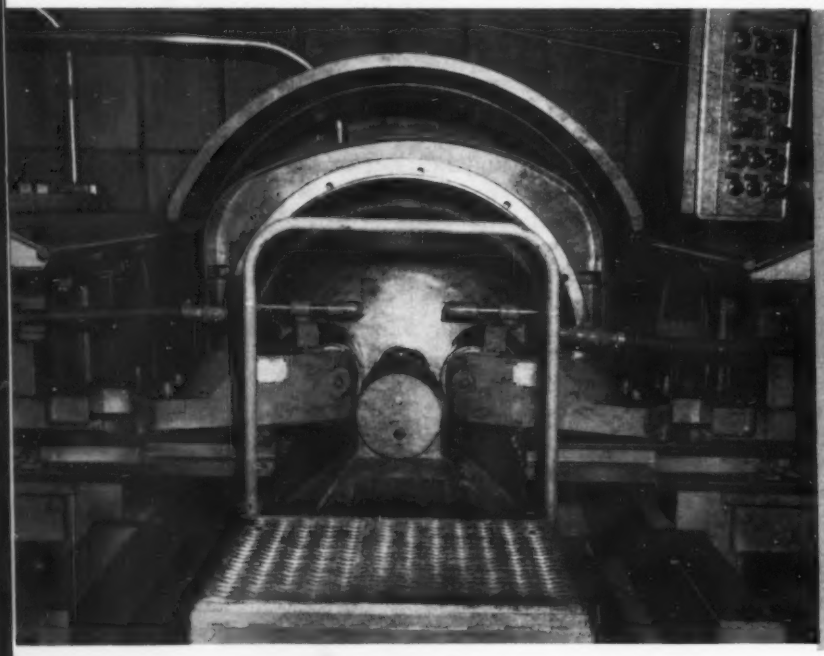


Fig. 3. Looking toward the forming rolls of the Hydrospin as they bring a rocket head to its dome shape.

The machine consists essentially of a huge expanding mandrel comprised of a series of segmental members that are expanded radially when a coupling beneath the machine pulls down a tapered arbor in the center of the segments. Operations are closely controlled from a console cabinet. A pressure of 600 tons is generally applied, although pressures to 1000 tons have been used.

Actual sizing occurs as the finished bottom face of the coupling contacts against a stop which can be adjusted to closely control the height at which this contact happens. The stroke position of the coupling is indicated at all times on the console cabinet. The memory system of the control unit permits accurate duplication of operations.

Most of this equipment is below floor level. Segments for various operations are supplied by the machine builder made from such materials as epoxy resins, glass laminates, Meehanite, and mild steel.

Circumferential welding of the large tubular chambers to the dome-shaped heads and similar operations are performed on the big machine shown in Fig. 4 which was built by the Cecil C. Peck Co., Cleveland, Ohio, and provided with Linde equipment for both Heliarc and submerged-arc welding. At the far end of the equipment, as seen in Fig. 5, is an induction-heating coil for preheating the metal adjacent to the weld that is to be made. The edges of the parts are preheated to 600 degrees F. The same induction-heating unit is applied for stress-relieving at temperatures up to 1150 degrees F.

The welding head itself is shown in Fig. 6 mounted on the end of a long ram. This arrangement permits of locating the welding head in any desired position within the work. Welding has been speeded up materially with this equipment and welding quality greatly improved.

Cylindrical parts are seam-welded with the equipment shown in Fig. 7, which was built by the Expert Tool & Die Co., Detroit, Mich. This machine is also provided with Linde equipment for both Heliarc and submerged-arc welding. The latter type of operation is shown being performed to join the ends of a large rolled sheet that will become a missile chamber.

One of the mechanical features of this machine

Fig. 4. Huge machine used for circumferential welding of large rocket sections by either Heliarc or submerged-arc welding.

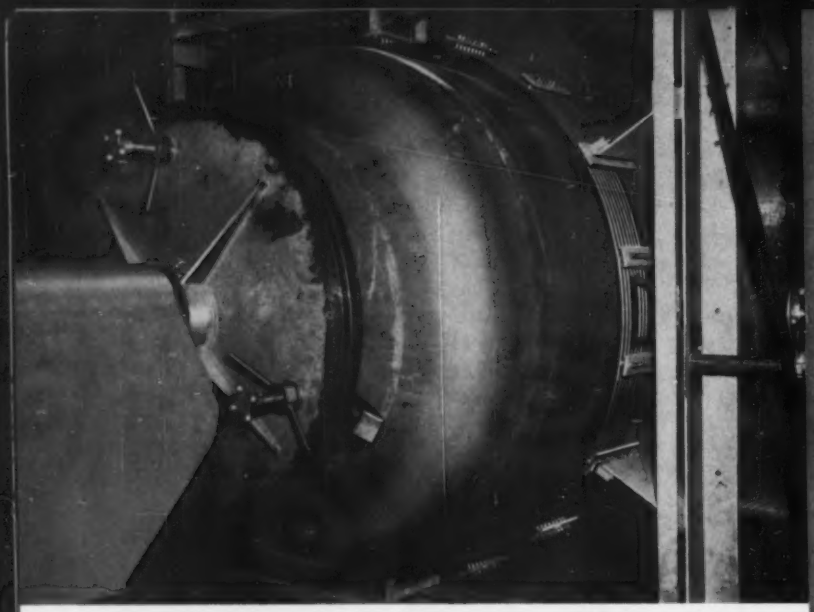


Fig. 5. Induction coil at left-hand end of welding machine in Fig. 4 which is used to pre-heat work areas to be welded and also for stress-relieving work after welding.

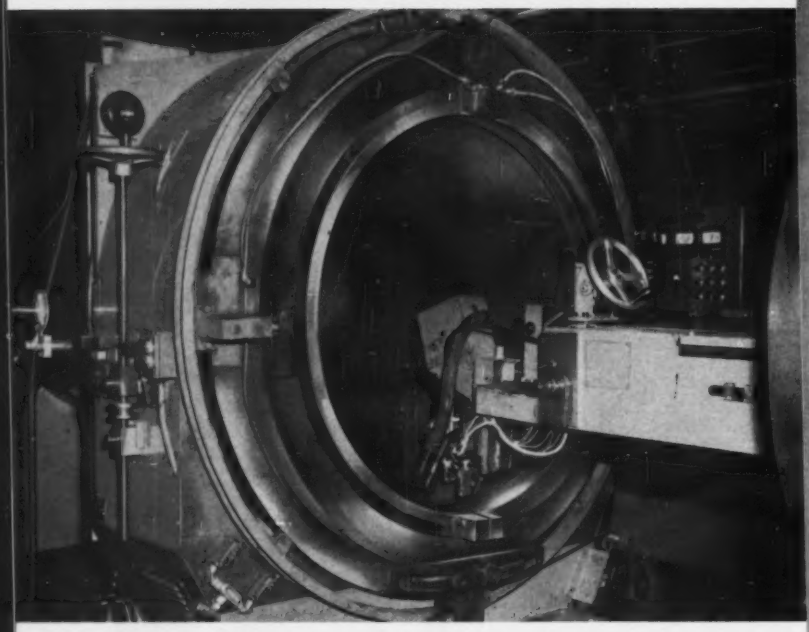


Fig. 6. Welding head of the machine in Fig. 4 which is mounted on the end of a movable ram to suit work of various lengths.

Fig. 7. Welding equipment employed for Heliarc or submerged-arc welding of longitudinal seams on large cylindrical sections.

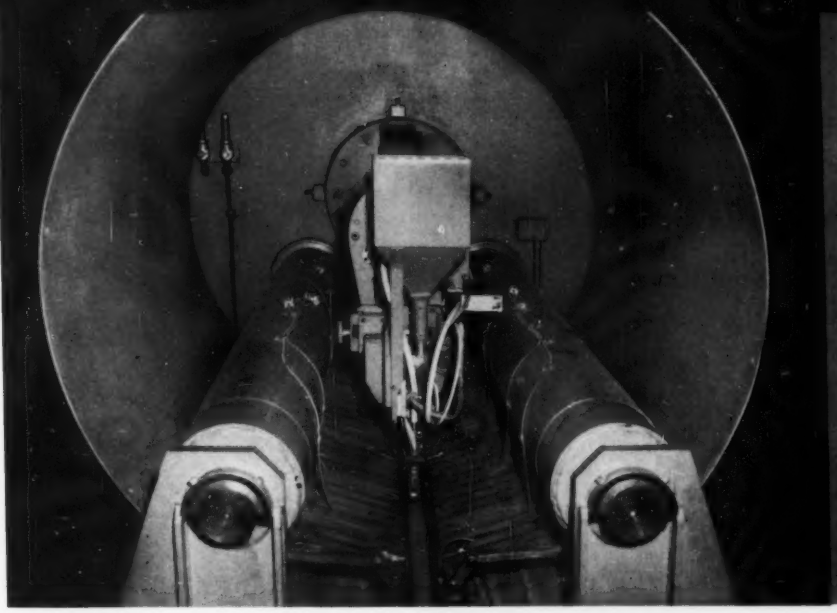


Fig. 8. A multitude of hydraulically actuated clamps hold the work edges to be welded securely in place for the operation.

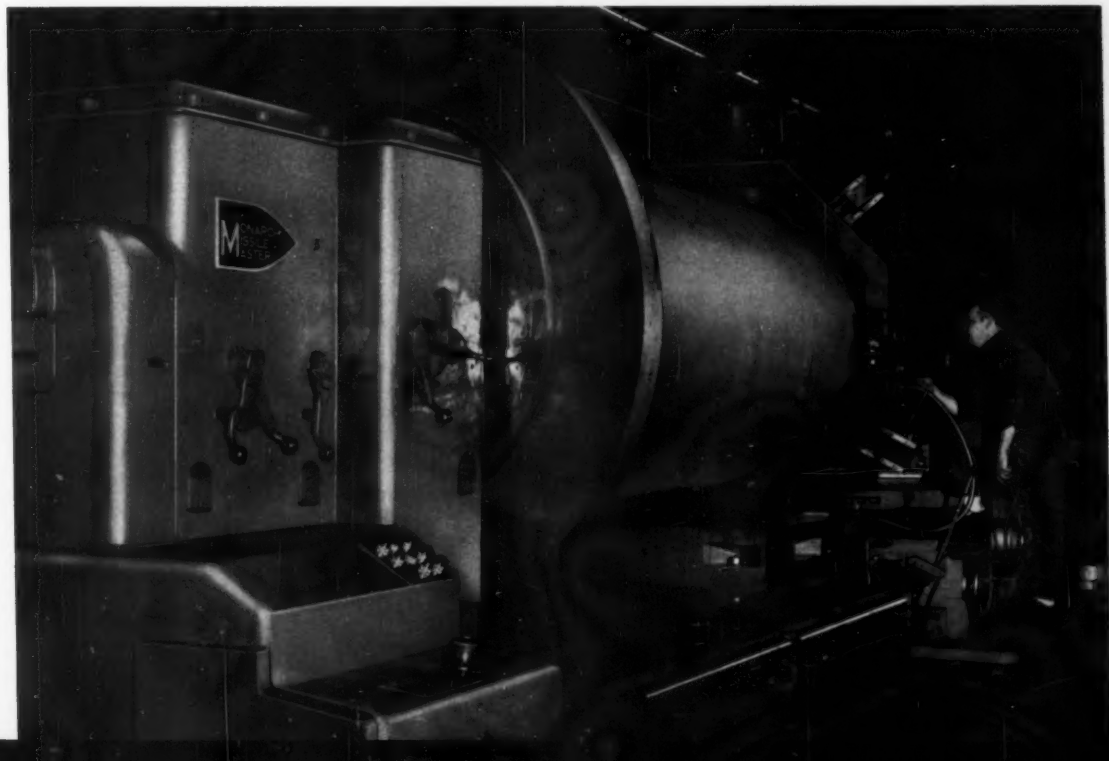
is the application of a multitude of clamping shoes for holding the work edges securely during the welding process. As shown in Fig. 8, these shoes are attached to long drums that are swiveled by hydraulic power to effect the clamping action. A force of 1000 psi provides a clamping pressure of 400 pounds per linear inch.

The largest metal-cutting machine tool in the plant is the Monarch Missile Master lathe illustrated in Fig. 9 which was built specifically for handling the huge parts inherent with intercontinental missiles. This lathe will swing work up to 65 inches in diameter over the cross-slide and 85 inches over the lathe bed. Work up to 21 feet long can be accommodated between centers.

In Fig. 9 a large rocket case is mounted in the lathe. Straight-turning, contouring, boring, and facing cuts are taken on this thin-walled part with carbide cutters. Contouring cuts are controlled by a template located between the bedways, where it is situated as close to the center line of the work as possible.

In Fig. 1, a turning cut is being taken on the dome-shaped head of the rocket case. The bore

Fig. 9. Huge lathe designed especially for handling the large cylindrical parts and dome-shaped heads that are built into ballistic missiles.



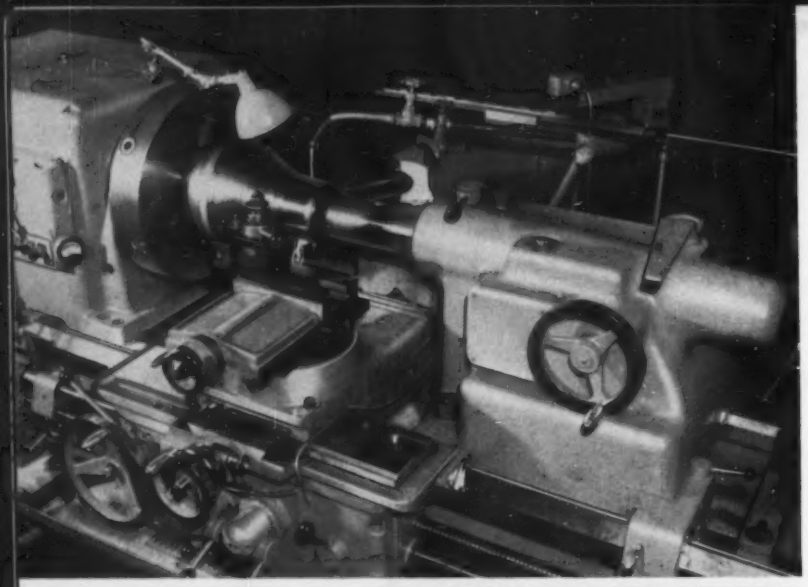


Fig. 10. Typical part being machined from pure molybdenum—a type of operation that originally presented specific difficulties.

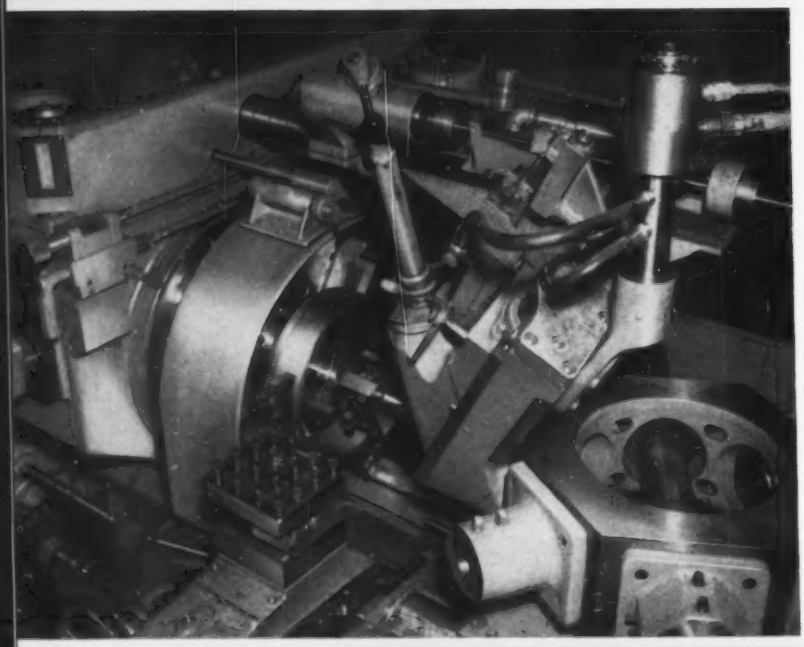


Fig. 11. Another molybdenum turning and facing job performed on a turret lathe equipped with an angular tool-slide controlled by a hydraulic tracer.

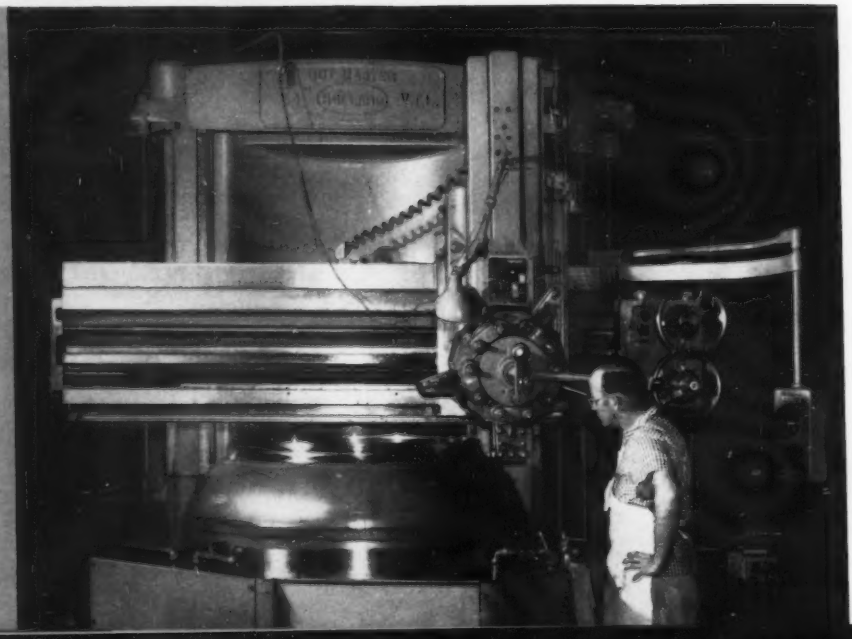


Fig. 12. Vertical turret lathe engaged in taking various cuts on a rocket head.

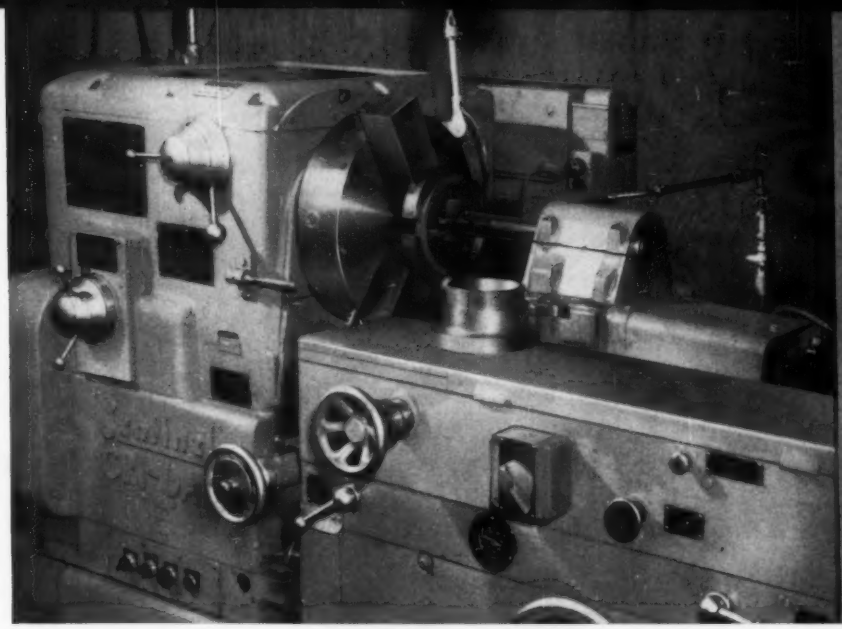


Fig. 13. High-speed lathe used for single-point thread-cutting on unalloyed molybdenum forgings.

is about 8 inches in diameter and is machined to size within plus or minus 0.002 inch. The rocket case is constructed of SAE 4340 steel plate.

Severe tool wear was a problem in machining the contoured part seen in the Axelson lathe in Fig. 10, which is made of pure molybdenum, until the most suitable type of carbide cutting material, desirable rates of speed and feed, and depth of cut could be determined. The work shape is controlled by means of a hydraulically operated tracer unit at the rear of the machine.

Low tool life is also experienced in machining the molybdenum housing ring seen in the Warner & Swasey turret lathe in Fig. 11. Cuts are controlled from a template at the top of an angular slide mounted on a face of the hexagonal turret. Desired tool movements are effected through a hydraulic tracer unit. There is a lead-screw adjustment of the angular tool-slide.

A series of turning, boring, and facing cuts is taken on a missile head by the Bullard vertical turret lathe seen in Fig. 12. This part, made of SAE 6434 steel, measures 54 inches in outside diameter. In this operation the work is run at 19 rpm. Carbide tools are used.

Two parts from unalloyed molybdenum forgings are seen in Fig. 13, one part being held in the chuck and the other lying on the carriage. The machine is a Cri-Dan high-speed threading lathe. Two threads of Class 3 fit are cut on the part lying on the carriage. One thread is 4 1/2 inches in nominal diameter and the other, 6 3/8 inches.

Originally, this job also presented difficulties. It was not possible to complete one threaded surface without several resharpenings of the single-point cutter. Abrasiveness and brittleness of the work material caused the problem.

Sharpening of cutters has been facilitated by the use of the principle of electrolytic grinding. In Fig. 14 is seen a Hammond cutter grinder employed for producing chip-breakers on carbide tool bits. It operates in conjunction with Anocut electric-spark equipment. The grinding wheel consists of a steel disc 12 inches in diameter with diamond dust bonded around the periphery.

With electro-grinding the diamond wheels have been found to last eight times as long as with conventional practice and the speed of sharpening has been greatly increased.

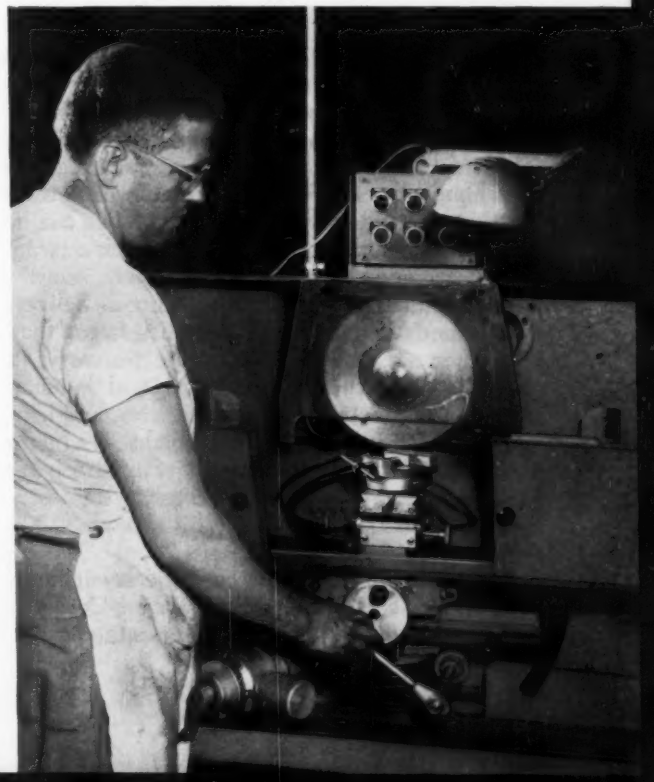


Fig. 14. Electro-grinding of carbide cutters has greatly speeded up sharpening operations and extended tool and diamond wheel life.

TAPES TAKE OVER REPUBLIC

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WHEN the Tactical Air Command puts its first wing of F-105 Thunderchiefs into service this year, it will have what has been described as "the world's most powerful one-man airplane." The Republic-built fighter-bomber, six years in development, can deliver nuclear weapons at nearly twice the speed of sound. Its range can be extended by in-flight refueling to attack a target of any size anywhere in the world.

A 20-millimeter automatic cannon delivers 6000 rounds per minute—four times faster than any other airborne gun. The ship can carry, in addition to its nuclear weapons and cannon, various combinations of rockets, missiles, conventional bombs, and napalm bombs. Its bomb bay is longer than that of the famed Flying Fortress. A sophisticated fire-control system permits pinpoint bombing from altitudes of 50,000 feet up or at tree-top level.

For machining many of the intricate airframe parts in the F-105, Republic Aviation Corporation, Farmingdale, N. Y., now operates the largest and most complete numerical-control installation on the East Coast. Included are two mammoth, gantry type skin mills, one five-axis profiler, and two three-axis profilers. Facilities for preparing the required magnetic and punched tapes are located on site.

In the relatively short time that the equipment has been operating—some of the machines have been handling production pieces only a few months—highly favorable contrasts with the tracer-machining methods formerly used have become apparent. There has been a substantial improvement in the accuracy of the machined surfaces. Tighter tolerances, practical because of the almost phenomenal repeatability of the machines, have, in turn, reduced inspection time. Savings in machining time have run from 65 to as high as 85 per cent, and in tooling costs, from 40 to 60 per cent. Other significant advantages already realized are reduced tool storage and handling requirements, reduced lead time, and savings in floor space.

THUNDERCHIEF PRODUCTION

Most of the success of the program to date, it is felt, stems from early coordination of the various talents involved back in 1956, well before the first piece of equipment was installed. A team that was formed at that time has been functioning continuously. It includes mathematicians (some with Ph.D's) from the computing department, engineers from the plant equipment, tool design, and tool planning departments, machinists and foremen from the manufacturing division, and millwrights and electricians from the maintenance division. Key people spent several weeks at schools conducted by the equipment suppliers.

One of the two skin mills appears in Fig. 1. On the right can be seen part of its control cabinet. The machine, built by Giddings & Lewis, is operated by a General Electric Numericord magnetic-tape system. In this system, decimal numerical data for all machining functions are programmed directly from part drawings and converted electronically into time-motion-coordinated, electrical-machine-command signals.

Two 100-hp, water-cooled, high-speed heads (1800/3600 rpm) carried on the cross-rail simultaneously mill aluminum wing and fuselage sections for both sides of the airplane from the same tape. Thus, only one "hand" need be programmed for both sections. In Fig. 1, the heads are shown machining two wing rear spar caps. On the front of the table, which measures 10 by 30 feet, two outboard wing skins are set up. A close-up view of the skins in machining position appears in Fig. 2. Approximately 90 per cent of the total machining of this part is performed on this skin mill.

All three feed motions, as well as the feed rates, are controlled by the magnetic tape. Signals from the tape are stepped up to suitable voltage by amplifiers. Control equipment directs the voltage to direct-current motors which determine the angular positions of the ball screws in the feed system. Full horsepower is delivered by the motors regardless of the feed rate.

A better view of the control cabinet appears in Fig. 3. The magnetic tape is contained in the transport unit on the right-hand portion of cabinet. Positioning and adjustment controls are grouped on the panel on the left. Also, a dual pendent control is fitted on the cross-rail, enabling the operator to target the cutters before machining the initial pieces in a production lot. The only manual operation of the equipment involved is the targeting of the cutters to the starting point and the setting of the cutters to proper depth.

The magnetic tape is a Mylar plastic material which has high resistance to heat and moisture. There are fourteen channels on the tape, capable of controlling all motions of the machine (one channel per motion) as well as auxiliary functions such as turning the coolant on and off, starting and stopping the chip-collecting system, etc. The tape is 7200 feet long and travels past reading heads in the transport at a continuous rate of 75 feet per minute.

Work-pieces are secured to their fixtures by vacuum. While several airframe companies have adopted vacuum clamping techniques, Republic, it is believed, is the first to apply them where the backing surface of the work is contoured rather than flat.

In Fig. 4, for example, is shown a rear-spar-cap rough forging about to be positioned on its vacuum chuck. The fixture is a steel weldment which supports a plastic contoured form. This form matches the backing surface of the spar cap. To develop the contour, a liquid plastic resin is poured over a conventional airframe plaster form. After the plastic sets, vacuum grooves can be machined in it (from a previously prepared tape)

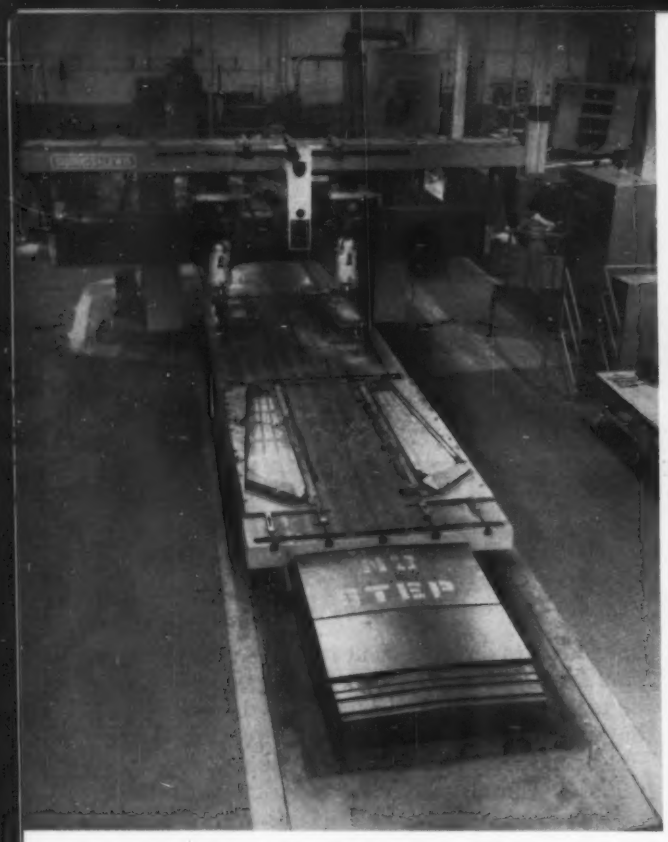


Fig. 1. One of the two skin mills which dominate the structural machine shop. Wing skins, on front of table, start out as aluminum plate, and are contoured and tapered in a preparatory slab-milling operation. Wing rear spar caps, on rear of table, are die-quenched aluminum forgings.

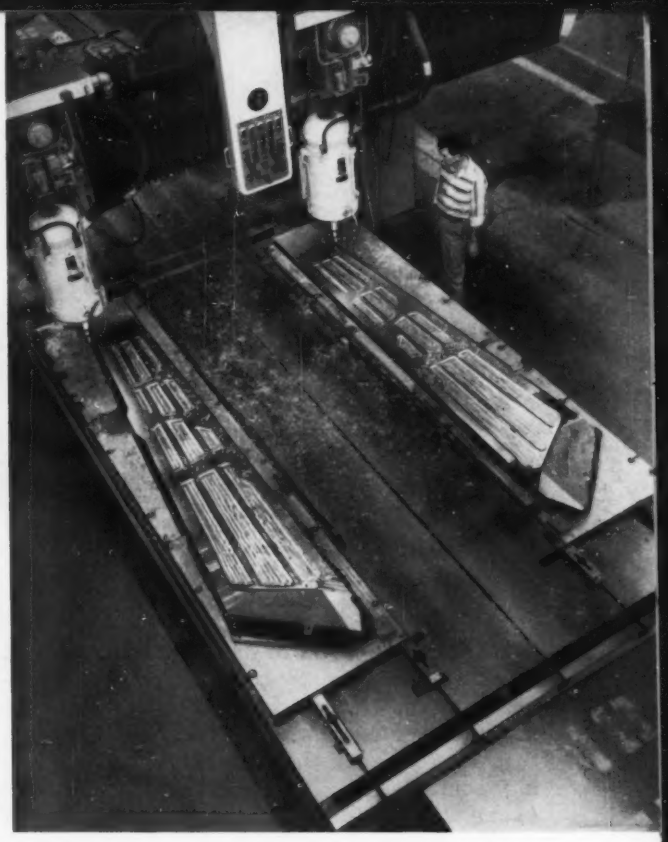


Fig. 2. The two high-speed heads simultaneously mill left-hand and right-hand outboard wing skins from the same tape. Two-fluted carbide end mills are used for the periphery and the pockets. Turning on and off of mist coolant is one of several auxiliary functions programmed into the tape.

right on the skin mill. The hose seen along the front of the fixture weldment unwinds from a reel located on the shop floor behind the table of the machine. Portholes in the chuck, from which the vacuum grooves radiate, are connected to one end of the hose. The other end of the hose is connected to a pump. There are two hoses, reels, and pumps—one of each for the fixtures located on each side of the table.

The Giddings & Lewis five-axis profiler appears in Fig. 5. Like the skin mills, it is operated by a Numericord magnetic-tape system. In addition to the "X, Y, and Z" movements of the conventional profiler, the head can swivel in a vertical plane,

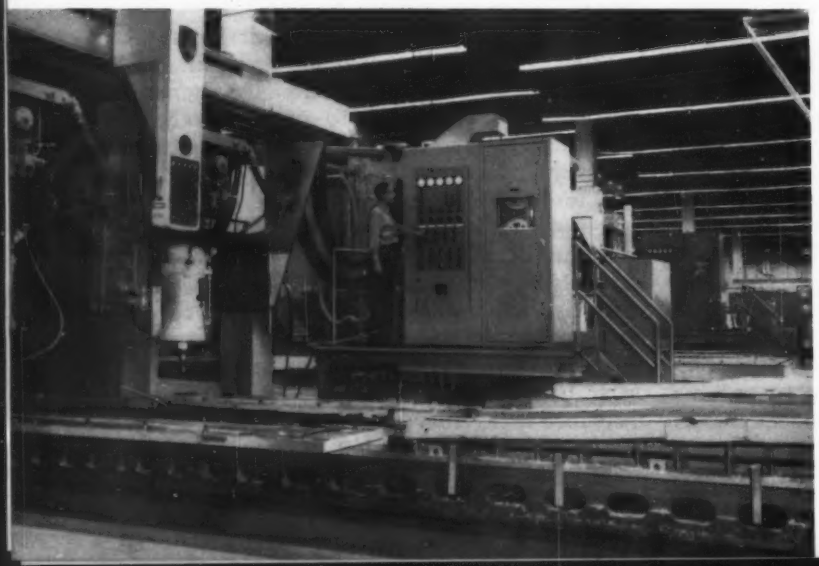


Fig. 3. The two reels for the magnetic tape can be seen in the window of the transport unit next to the control cabinet. While this type of tape is relatively expensive, it is possible to "erase" the electrical signals, and re-use it on other jobs. Punched paper tape from which magnetic tape signals are obtained remains as a permanent, easily stored record.

Fig. 4. Contoured vacuum chucks are claimed to be a Republic "first." Pumps at rear of table running intermittently maintain the vacuum. Holes in the part flange locate over pins in the fixture. Contoured feature affords a firm support for the high-speed milling.

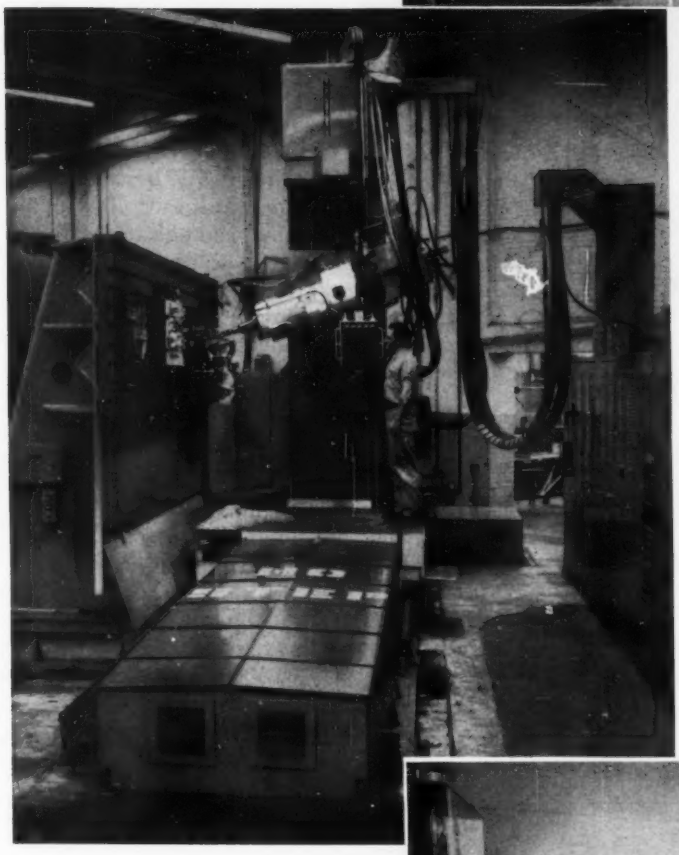


Fig. 5. The 20-hp head on the Variax is profiling a root frame for the fuselage of the Thunderchief. A reinforcement frame and a windshield frame are also set up on the angle-plate fixture. Five-axis flexibility of the equipment speeds swarfing cuts.

Fig. 6. In a separate room, the magnetic tapes are prepared for different jobs handled on the two numerically controlled skin mills and the five-axis profiler. Part design changes can be processed on tape in advance and thus be ready for later production change-over.

Fig. 7. The two low-speed profilers are operated by a Bendix punched-tape system. This tape, made of plastic-coated aluminum, is inexpensive, and moves only when a new command is given. If required, the machine tool operator can override the programmed feed rates. Tape is mounted on photoelectric reader in transport.

and the column can swivel in a horizontal plane. All five movements are controlled simultaneously from magnetic pulses on the one tape.

Assigned to this machine are aluminum airframe parts in which continuously changing angular cuts have to be taken. Head rotative speed is high—1800/3600 rpm.

In Fig. 6 is shown the Numericord director used for preparing the magnetic tapes for the skin mills and the five-axis profiler. The unit converts decimal numerical data on a paper tape (previously prepared from IBM punched cards) to time-coordinated, continuous electrical signals. In the cabinet seen on the right, the electrical signals are then recorded on the appropriate channels of a reel of magnetic tape.

The Numericord equipment is maintained in an air-conditioned room. Republic has been designated by the Air Force as a "Director Center" to furnish magnetic tapes for East Coast companies without processing facilities of their own.

Punched, rather than magnetic, tapes operate the two Kearney & Trecker low-speed profilers, one of which appears in Fig. 7. These machines handle high-strength steel work as well as aluminum. Spindle speeds range from 36 to 1800 rpm.

Feed rates and path motions are controlled automatically from coded information punched on plastic-coated aluminum tape. A Bendix tape-control system which involves hydraulic powering of the feed screws is utilized. The part being profiled in the illustration is an inboard spar cap for the F-105.

This "pork chop" aluminum forging is shown separately in Fig. 8. All of the rib cuts follow a continuously changing contour. Numerical control has reduced machining time from twenty-seven hours to less than ten. In addition, the tape has eliminated the need for the elaborate tracing model (Fig. 9) required by the former milling method. Each plane has four different configura-

Fig. 8. (Left) This "pork chop," three-dimensional wing spar cap was one of the first F-105 parts to be machined by numerical control. Received as a forging, the part is held vertically for profiling, as can be seen in Fig. 7.

Fig. 9. (Right) Formerly, the "pork chop" was profiled by conventional tracer methods. This model is one of four which had to be constructed.

Fig. 10. The IBM 704 computer room has sufficient storage capacity for the sub-routines of complex three-dimensional parts. Besides Republic's needs, tapes for contractors without computer facilities of their own also are processed here.

tions of the "pork chop," and required a different tracing model for each.

Now, two punched tapes serve all configurations. A switch at the machine-control unit changes the profiling motions from one hand to the other. Programming of the tape cost substantially less than preparing the models (a saving of 56 per cent). What is more, it is anticipated that far greater savings will be realized as advanced computer techniques, such as the APT system, are developed. (See "Numerically Controlled Tool Data Prepared from Written Specifications," MACHINERY, April, 1959, p. 162.)

A view of Republic's IBM 704 computer room appears in Fig. 10. The computer does the work of 2000 engineers using slide rules, and does it with a far higher degree of accuracy. To process a tape—either magnetic or punched—cards are prepared from the part programmer's manuscript. Essentially, the information in the manuscript describes the line-intersection points on the part, radii which define contours, feed rates, tolerances, and auxiliary functions like turning the coolant on and off. The computer breaks the curved lines of the part drawing down into straight sections, within tolerance, and calculates the path of the center of the cutter.

Other versatile equipment newly installed to build the F-105 are five large Sundstrand machines—three Omnimils and two Rigidmils. Two of the former appear in Fig. 11. This equipment has been designed specifically for taking heavy cuts on large aluminum parts and for machining high-strength steel and titanium as well. All-angle milling heads equipped with high-speed and low-speed spindles enable a variety of operations to be performed with a minimum of work resetting.

On the Omnimil in the foreground, two large fixtures hold wing spar caps for machining the splice plane. Two work-pieces are machined in the one setup.

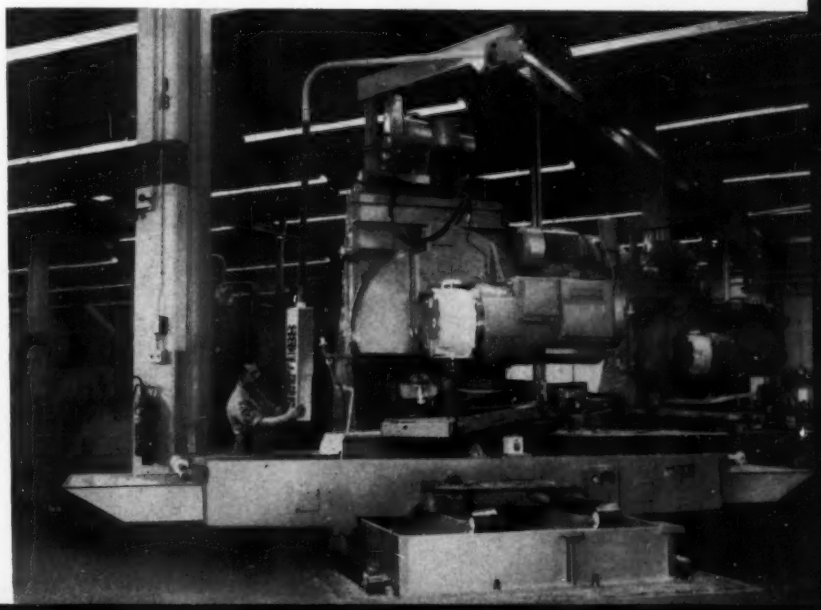


Fig. 11. These Omnimils do a variety of heavy-duty milling, drilling, and boring operations with a minimum number of setups. Machine in the foreground, equipped with a 12-inch carbide shell end mill, forms splice plane on the "pork chops."

CONVAIR ASTRONAUTICS

CHARLES O. HERB, Editor

PLANT — NEWEST OF THE SPACE VEHICLE INDUSTRY

Where the Atlas intercontinental missile is built, the first rocket of the free world to propel itself into orbit around the earth solely by its basic propulsion equipment

KEARNY MESA, outside of San Diego, Calif., is the site of the modern facility operated by the Convair (Astronautics) Division of the General Dynamics Corporation, for integrated research, development, and production of long-range missiles and space vehicles. Construction of this plant, which comprises six major buildings and fourteen smaller ones, started about two years ago. Transfer of the Astronautics Division to this new facility was completed only six months ago. The plant cost a total of forty million dollars, about half of which was provided by the General Dynamics Corporation for land, buildings, and some manufacturing equipment. The remainder was supplied by the Air Force to pay for machine tools and other equipment.

It is this plant that turns out Atlas intercontinental missiles for the Air Force. These stainless-steel missiles are 10 feet in diameter by approximately 75 feet in length. The final assembly line, when observed from the point where the heading illustration was taken, gives the impression that the free world is seriously engaged in arming itself to meet any foreign aggression.

The Atlas, incidentally, was the first ballistic missile to make a successful flight of intercontinental proportions. This occurred on August 2, 1958. Then, in December of last year, an Atlas missile propelled itself into orbit in outer space. Except for its jettisoned booster-engine package, the entire rocket went into orbit. This rocket was 82 feet long. The Atlas is designed to deliver a thermonuclear warhead more than 6325 statute miles from the point of discharge. It is powered by liquid-propellant rockets—two large boosters, one large sustainer, and a pair of small "vernier" rockets. All of these burn liquid oxygen and RP-1, a kerosene-like hydrocarbon. The take-off thrust is approximately 360,000 pounds.

Manufacturing operations in the departments where components for the missiles are turned out on a production basis, and where the missiles are assembled and checked, are classified information. But it is possible to describe operations in the department where parts are made on a small-lot production basis, where tooling equipment is made, and where some machine tools are set up and tried out prior to their transfer to production lines.

A most unusual job is shown in Fig. 1 being performed on a Sundstrand universal bed type milling machine. This operation consists of milling around an arc along the outer edge of two thick slabs of duralumin. The radius of the cut is 5 feet. The cutter revolves in one position and the work is fed past it by the swinging movement of two radius-bars which support the work. The radius-bars are actuated by a motor-driven turntable on the regular table of the machine. An end mill about 3 inches in diameter takes the cut. The outer ends of the radius-bars are supported by a curved steel bar as they swing through their arc.

This milling machine can be applied for a large variety of work as the head shown in use is of the "all-angle" type and is attached to a ram by which its cutter-spindle can be positioned anywhere across the bed. This spindle is driven by a 20-hp motor and is adjustable through an arc of 360 degrees, both parallel to the table and crosswise in relation to the table. It can be retracted to provide clearance for a cutter held in the regular horizontal spindle of the machine. The spindle

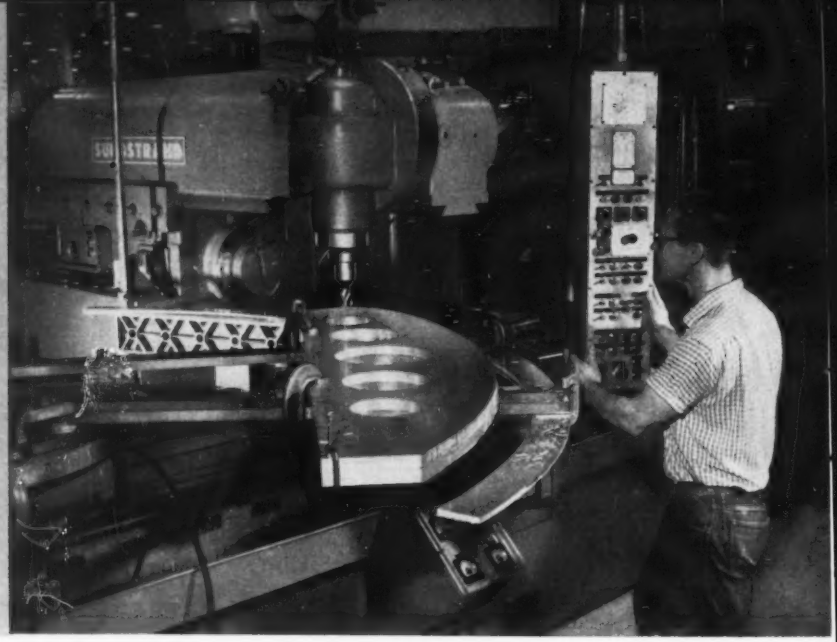


Fig. 1. Milling an arc of 5-foot radius in unusual setup on a universal bed type horizontal milling machine which has two cutter-spindles.

is driven by a 50-hp motor. There is provision for operating the machine by controlled tracing and programming if desired. Twenty-four speed changes are available on both the horizontal and "all-angle" spindles, ranging from 14 to 1450 rpm.

Work up to 144 inches long by 36 inches wide by 48 inches high can be handled on the Thompson hydraulic surface grinding machine in Fig. 2. It is shown being used in squaring up and finishing various surfaces on a master tooling gage required in manufacturing a component for the Canister missile. The 20-inch grinding wheel is mounted on a cross-feeding head attached to a cross-slide that is adjustable vertically by power on the column of the machine.

Missile components or tooling fixtures as large as 54 inches in diameter by 42 inches in height can be accommodated by the Giddings & Lewis vertical boring and turning mill illustrated in Fig. 3. In the operation shown, a conical aluminum missile part is turned, faced, and bored by cutters mounted on the turret of the vertical rail-head. After these cuts have been finished, the turret-head is raised and the angular head positioned for turning the upper portion of the conical surface. The tool advances at an angle of 45 degrees. All surfaces must be machined to size within plus or minus 0.0005 inch. The side-head of the boring mill is not applied in this particular setup. Incidentally, the angular head can be swiveled up to 45 degrees either side of vertical to suit a wide range of taper applications.

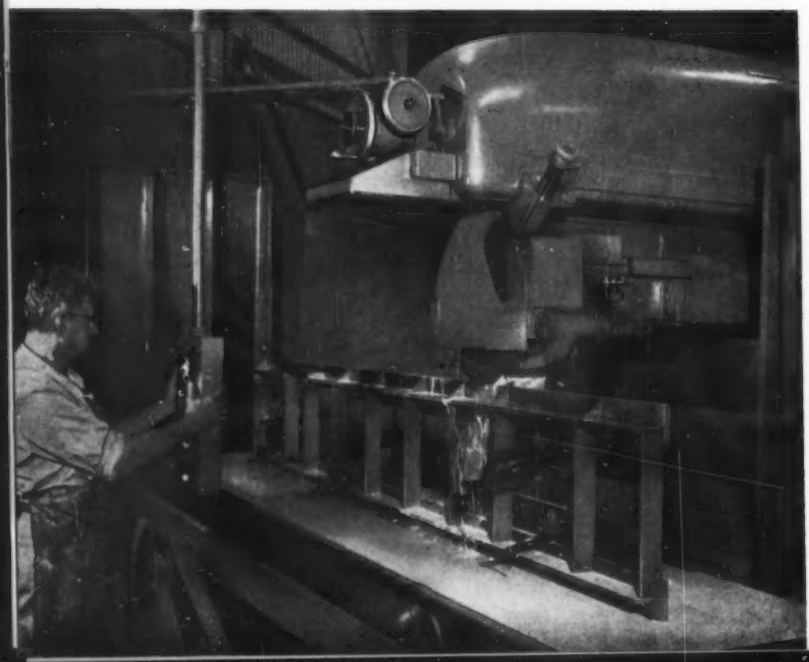


Fig. 2. Squaring and finish-grinding a large tooling gage on a surface grinder for use in the production of intercontinental ballistic missiles.

The 14-foot King vertical boring mill in Fig. 4 is engaged in machining a bulkhead ring from a stainless-steel ring that has a cross-section measuring 4 1/2 by 4 1/2 inches. The blank was rolled to required size from a straight bar and welded at the joint. When the part is completed, the cross-section is roughly in the form of the letter J. One wall is as thin as 1/8 inch. Dimensions are held within a tolerance of plus or minus 0.0025 inch. The finished ring is about 10 feet in diameter by 4 inches high. A feature of the machine is its hydraulic duplicating attachment.

In roughing, the cut is about 0.200 inch deep and in finishing, 0.030 inch. The part is run at a speed of 5 rpm, which gives a surface speed of about 160 feet per minute. The feed in roughing is 0.016 inch and in finishing is 0.008 inch per revolution. Carbide cutters are used. Exceptionally stringy chips are obtained.

A huge Keller machine is employed for taking milling cuts in three-dimensional planes. The particular operation shown in Fig. 5 consists of finishing comparatively small magnesium parts required for optical tooling equipment. Obviously, much larger work can be handled as the vertical

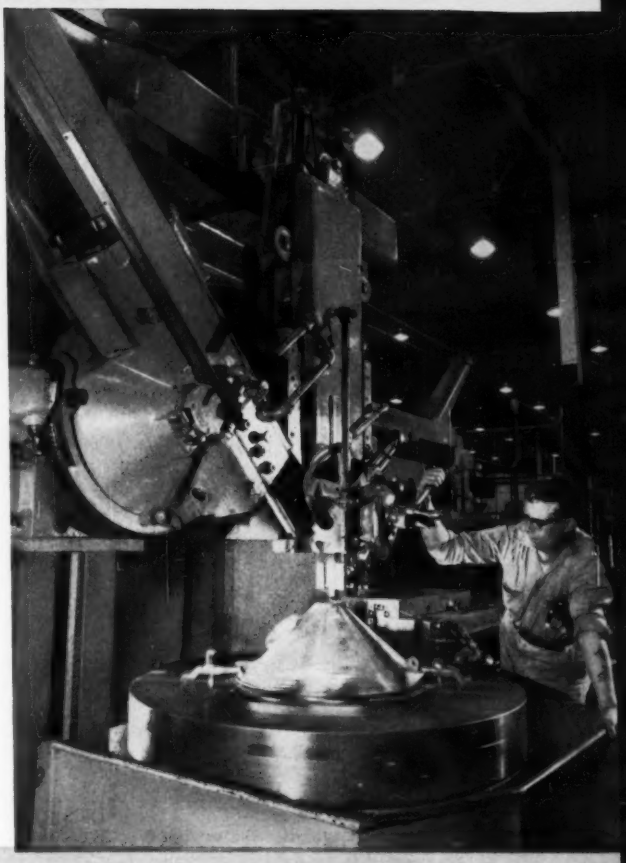


Fig. 3. (Above) After a series of turning, facing, and boring cuts on the missile part seen on this vertical boring and turning machine, the angular head finish-turns part of the conical surface.

Fig. 4. (Below) Vertical boring mill with hydraulic duplicating attachment seen producing a J-shaped bulkhead from a steel ring of square cross-section. Table speeds range up to 40 rpm.

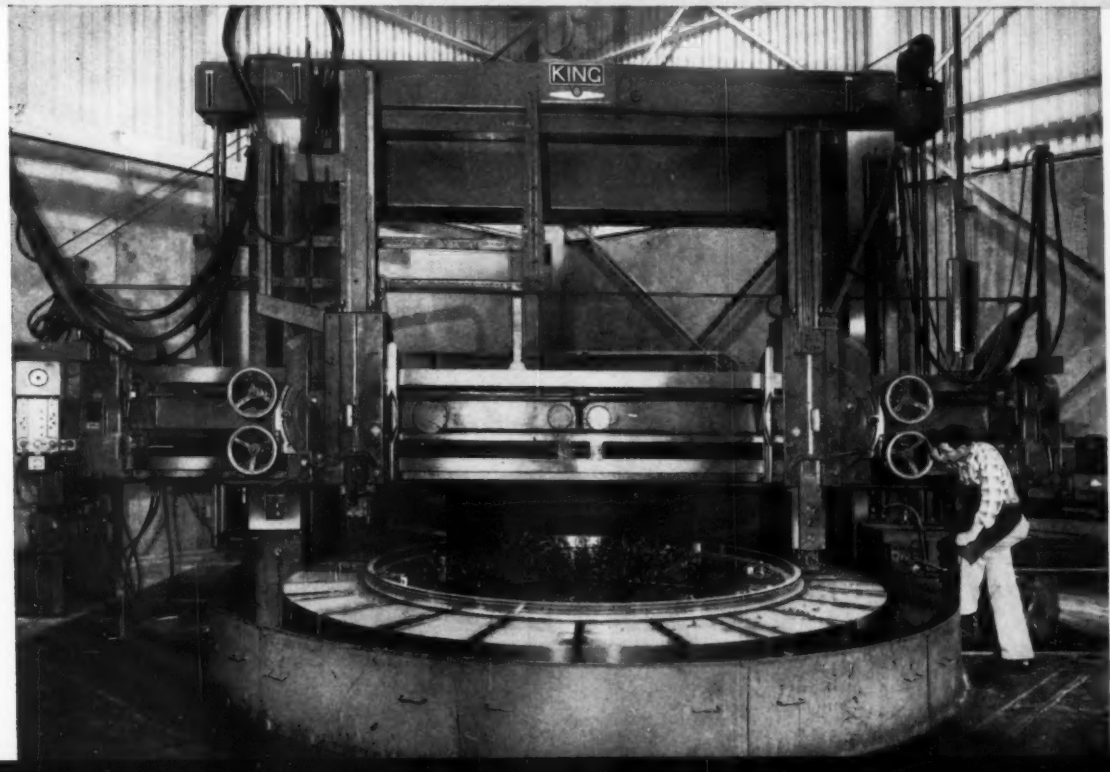


Fig. 5. Huge Keller machine applied for three-dimensional milling of parts varying greatly in size that are duplicated from corresponding templates.

angle-plate for holding the work and its template is approximately 72 inches wide by 36 inches high.

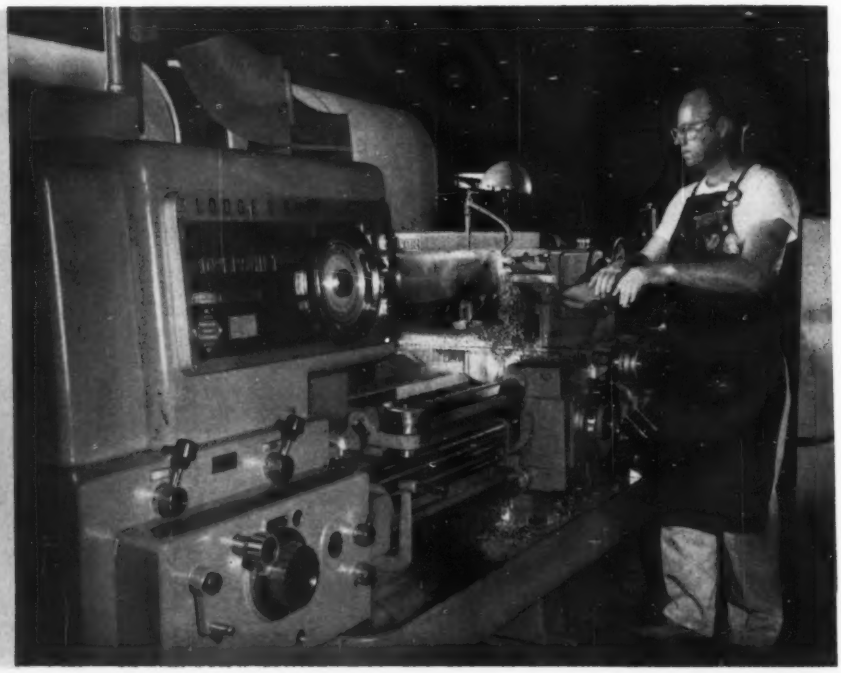
A Lodge & Shipley Copymatic lathe with a "Powershift Preselector" is seen in Fig. 6, starting an operation on a round bar of stock that will transform the blank into a launcher pin shaft. The tracer unit will control the turning of straight lengths, tapers, and a spherical section. The finished surfaces are produced within 0.0005 inch of the template contour.

In Fig. 7 the same machine is being used for boring a hole 5 1/4 inches in diameter to a depth of 3 1/2 feet in a piece of chromium-molybdenum tubing. The bore is held to size within plus or minus 0.001 inch for its entire length. It will be observed that the boring-bar is clamped securely to the cross-slide.

One of the features of this lathe is that while any cut is being taken on a part, the operator can pre-select the desired spindle speed for the next cut. Thus, idle time is eliminated. The use of the correct speed for each work diameter minimizes tool wear and tool changing, and consequently, costs.

A Cincinnati Hydro-Tel milling machine engaged in taking profiling and three-dimensional cuts on a slab of magnesium is illustrated in Fig. 8. The part is a support for a helium bottle. The perimeter of the part is profiled and various

Fig. 6. Copymatic lathe on which the desired speed for a consecutive cut can be pre-selected, thus reducing non-cutting idleness.



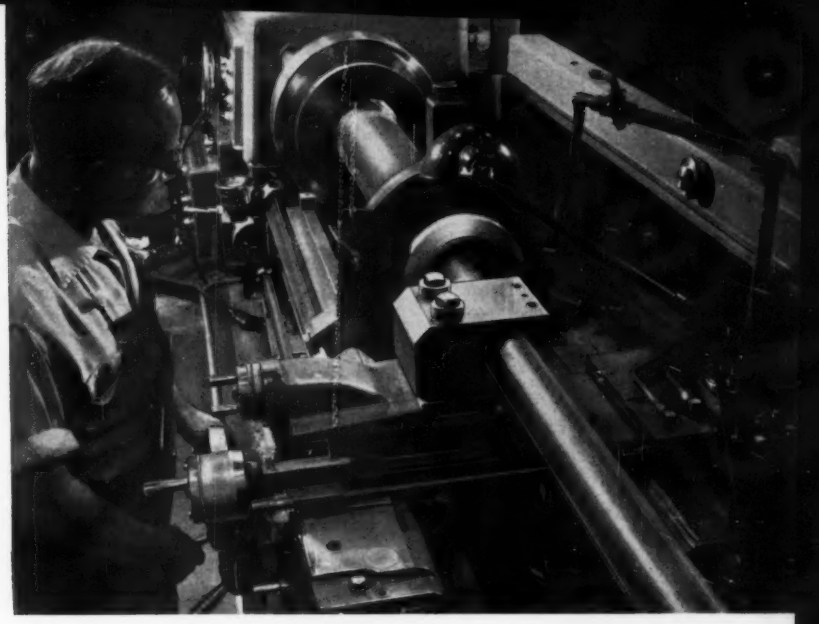


Fig. 7. Long boring operation on the Copymatic lathe with the cutter end of work supported in a steadyrest and the boring-bar mounted on the carriage cross-slide.

pockets are milled as the cutter is guided along different paths under the control of the stylus on the tracing unit seen in the foreground. The intricacy of the operation can be understood by observing the details of the template. Tolerance on all dimensions is plus or minus 0.002 inch.

Incidentally, all machines operating on magnesium are provided with a compressed-air unit for instantly covering the work with pure ground graphite in the event that magnesium chips catch fire. Several advantages are derived from the use of graphite, the primary one being that there is no damage to sliding machine surfaces, as may occur when sand is used to extinguish a blaze.

Jig-boring machines of several types are installed in a dust-free, temperature-controlled room. A Pratt & Whitney jig borer set up with a rotary indexing head is shown in Fig. 9 being used for accurate drilling and boring operations on a complicated spider-like weldment. This weldment will be used as a fixture for holding bulkheads during welding operations.

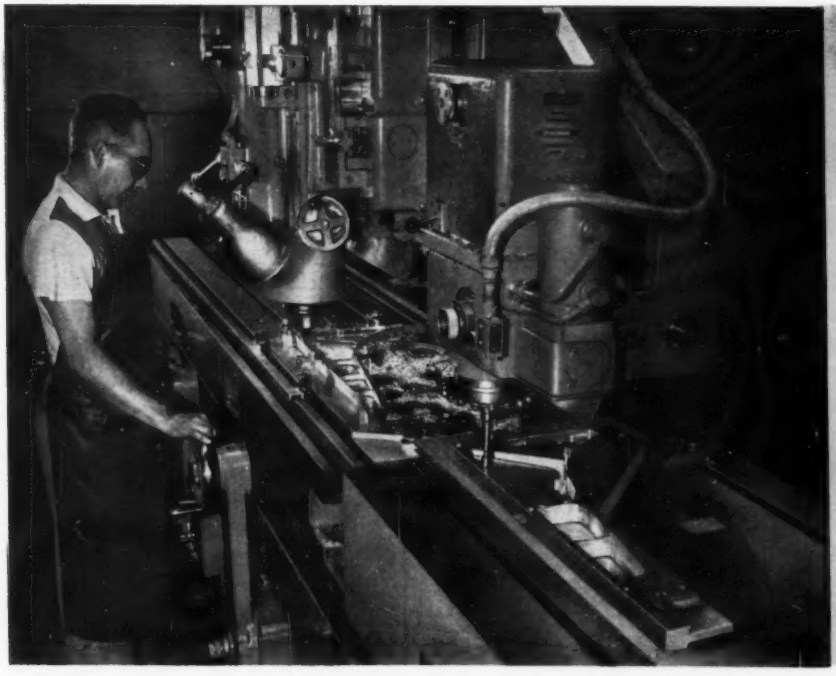


Fig. 8. Accurate duplication of supports for missile helium bottles is accomplished by this Hydro-Tel milling machine. Template is seen at right.

Fig. 9. Setup of complicated welding fixture on a jig-boring machine being checked with dial indicator after the performance of a series of accurate drilling and boring operations.

To accommodate high work, this jig-boring machine has an extended column. The column is 18 inches higher than on the standard machine. The indexing head is 24 inches in diameter.

Practically all incoming raw material, including steel alloys, aluminum, magnesium, chromium, molybdenum, and titanium in the form of forgings, castings, extrusions, and sheets, is inspected ultrasonically. The only exceptions are die-castings, which are inspected by means of an X-ray technique.

One of the most recent machines to be installed in the shop is the huge Bullard vertical turret lathe in Fig. 10. This machine has a table swing of 76 inches, and work up to 81 inches high can be accommodated. The table can be run at speeds up to 300 rpm. In the operation illustrated, turning cuts are being taken simultaneously by the side-head and one rail-head on a handling tool for the Atlas missile.

Ultrasonic inspection is performed in a tank of water 12 feet long by 22 feet wide, of which one corner is visible in Fig. 11. Ultrasonic readings of work placed in the tank are taken by the Sperry control at the left. A quartz crystal 3/4 inch in diameter is passed over the work. This crystal is mounted on a carriage that can be operated crosswise on a crane-like beam that spans the water tank and runs on tracks extending along both sides of the tank.

On rectangular or square sheets and many

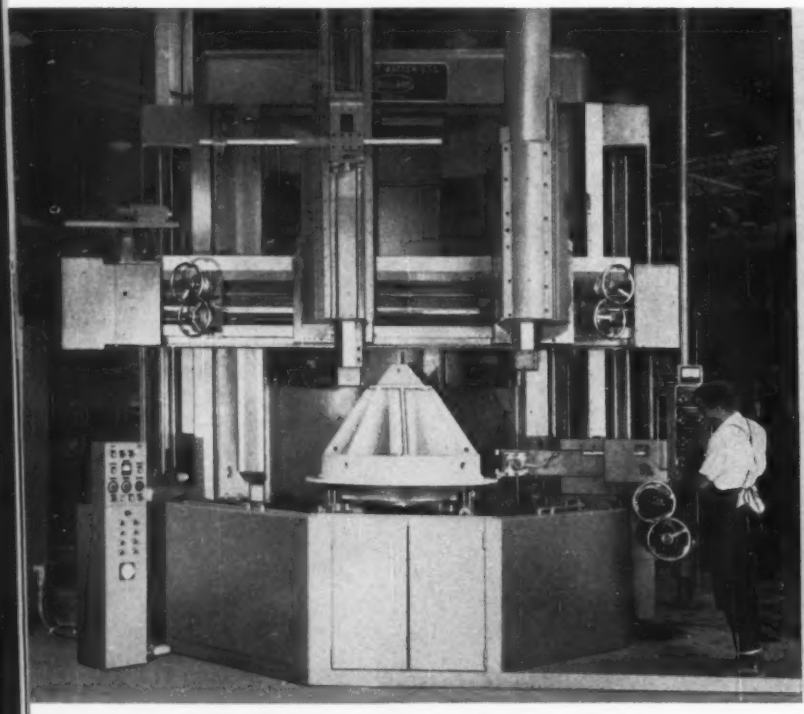


Fig. 10. Vertical turret lathe of unusual size engaged in machining a handling tool for the Atlas missile.

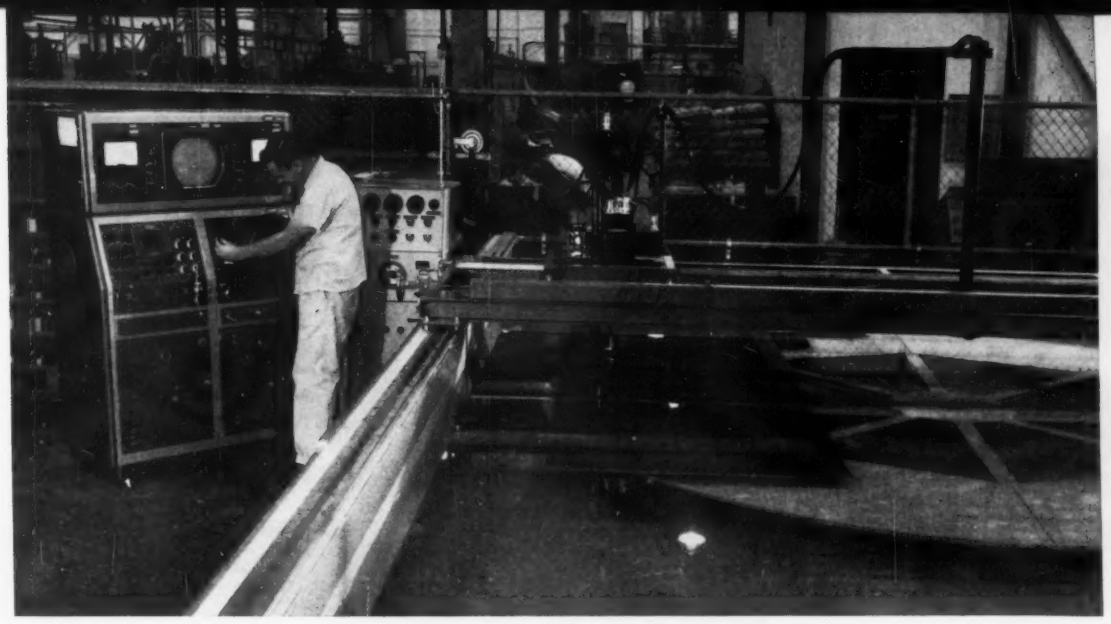
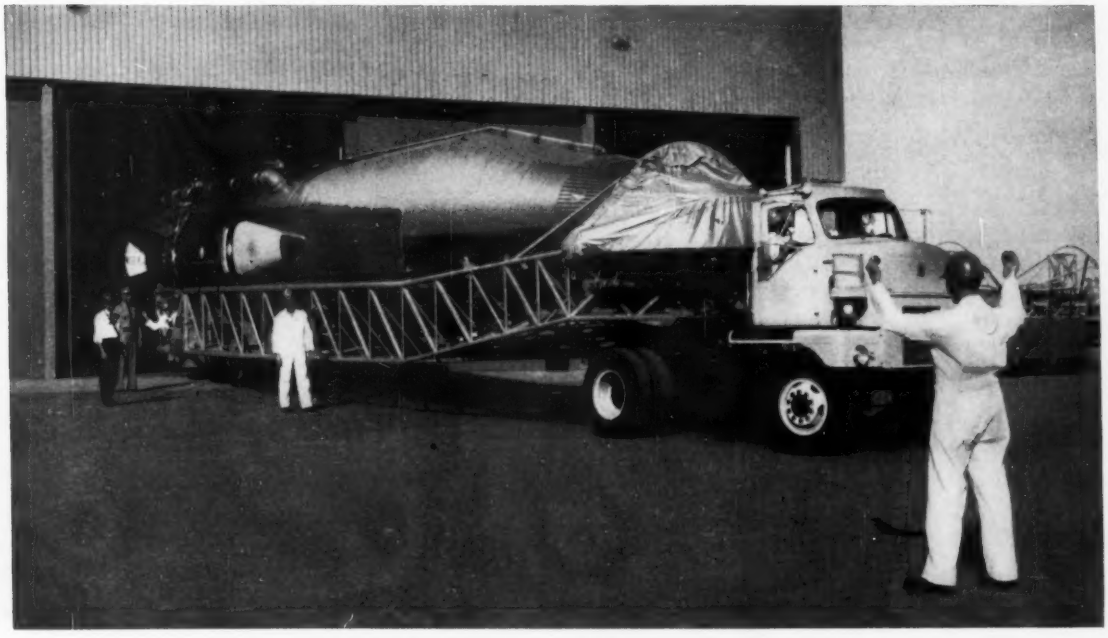


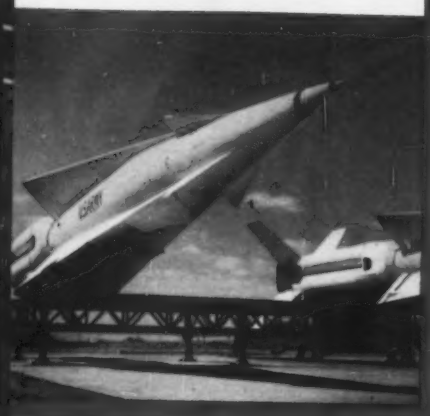
Fig. 11. Ultrasonic testing equipment which is used to check the quality of practically all metal sheets, forgings, castings, and other supplies that come into the plant.

other parts the crystal is passed over the work in a series of paths 5/8 inch apart. The back and forward movements of the beam and the crosswise adjustment of the quartz crystal between each traverse of the crystal are controlled from the console. Any defects in the work are transmitted by ultrasonic sound waves to the interpreting unit on the console.

Near the center of the tank as seen at the right is a large turntable on which rings and other circular parts are placed for inspection. In such cases, the work is revolved slowly beneath the quartz crystal. The latter is shifted a distance of 5/8 inch sidewise with each rotation of the work. There is no change in the setting of the crossbeam during the inspection.

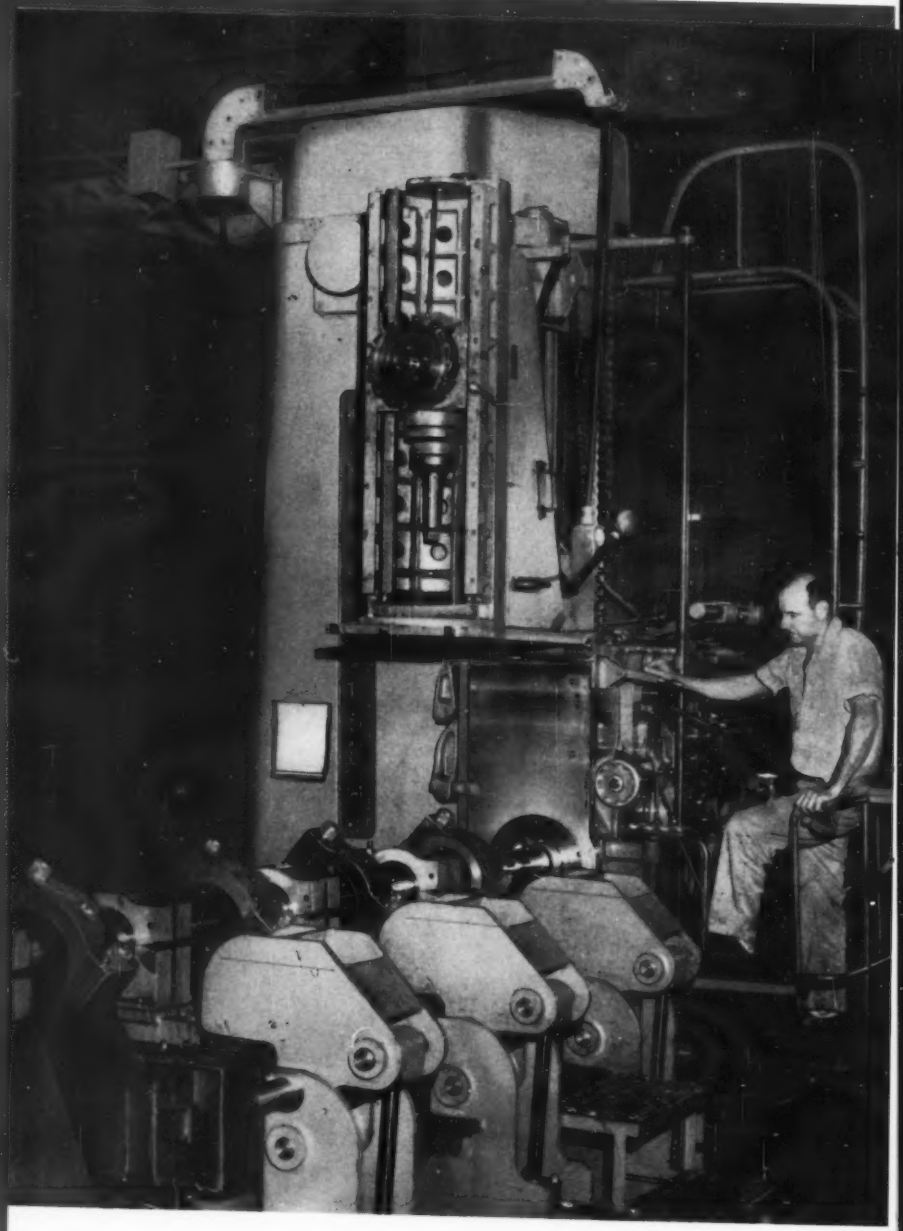
Fig. 12. Completed Atlas intercontinental ballistic missile leaving the Convair-Astronautics plant on its way to Cape Canaveral.





SPECIALIZED NIKE-HERCULES

CHARLES O. HERB
Editor



MACHINE TOOLS BUILD MISSILE LAUNCHERS

Production lines in a southern California plant of the United States Steel Corporation are set up to fill present needs and meet possible national emergencies

PARTICIPATION in a variety of development and manufacturing projects in the missile, avionic, atomic-power, and space fields is an important activity of the Consolidated Western Steel Division of the United States Steel Corporation. The Maywood (Los Angeles) plant, for example, has installed a great amount of highly special equipment for turning out, on a truly production basis, major components of ground-handling and launching equipment for Nike-Hercules air-defense guided missiles. Standard machine tools are applied wherever possible, but the work dimensions of the larger parts and the desired production rates necessitated the design and installation of many machines that are unique in a considerable number of respects.

This article will deal primarily with the special equipment used in producing parts for the Nike-Hercules launching equipment under a contract from the Douglas Aircraft Co. Major components include launching and transport rails and launcher-loaders. Close dimensional tolerances are specified for all structural members to insure complete interchangeability.

Rails 25 feet in length are machined by specially designed equipment utilizing two Newton heads, as shown in Fig. 1, for longitudinal milling and one transverse head for end milling. The two heavy-duty milling heads are mounted on opposite sides of the machine and traverse along the bed in machining the rails over their entire length. Each head is equipped with three cutters as shown in Fig. 2. With this triple arrangement of cutters, the top, bottom, and edge surfaces of two long bars running along the top of the weldment and two bevels are simultaneously machined—in other words, ten distinct surfaces.

At one end of the machine there is a separate horizontal milling unit, as shown in Fig. 5, which is fed crosswise to take a facing cut over the end of the rail.

It is customary to have the one milling head precede the other by several inches. The cutters are set in accordance with a gage bar permanently attached to the work fixture. When finished, the distance between the two edges of the bars must be 18 inches within plus or minus 1/32 inch and the thickness of each bar must be between 0.600 and 0.620 inch. This is accomplished in a single pass. Carbide blades are used in the inserted type cutter-heads.

The cutter-heads are fed at a rate of 16 inches a minute and the depth of cut on all surfaces is about 1/8 inch. The material is hot-rolled steel. Covers provided the length of the fixture, as seen in Fig. 1, prevent chips from falling into the various depressions along the work and direct them down on a belt conveyor. The conveyor carries the chips to a pit from which they are removed daily.

Adjacent to the machine tool just described is another special machine designed to utilize two Cincinnati independent over-arms as illustrated in Fig. 3. This equipment has two milling heads on carriages that can also be traversed the length of the 25-foot rails for machining either crosswise

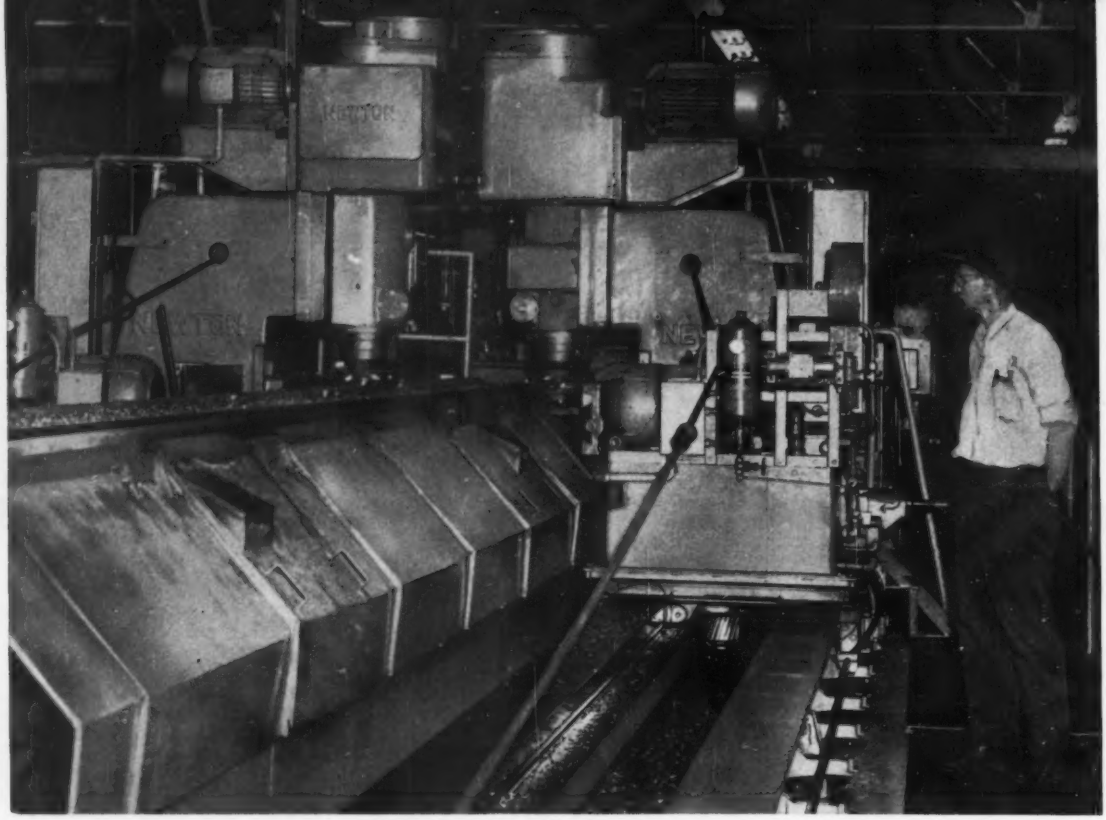


Fig. 1. Rocket-missile launcher rails have five surfaces milled for a length of 25 feet on both sides of the frames by this huge two-head machine.

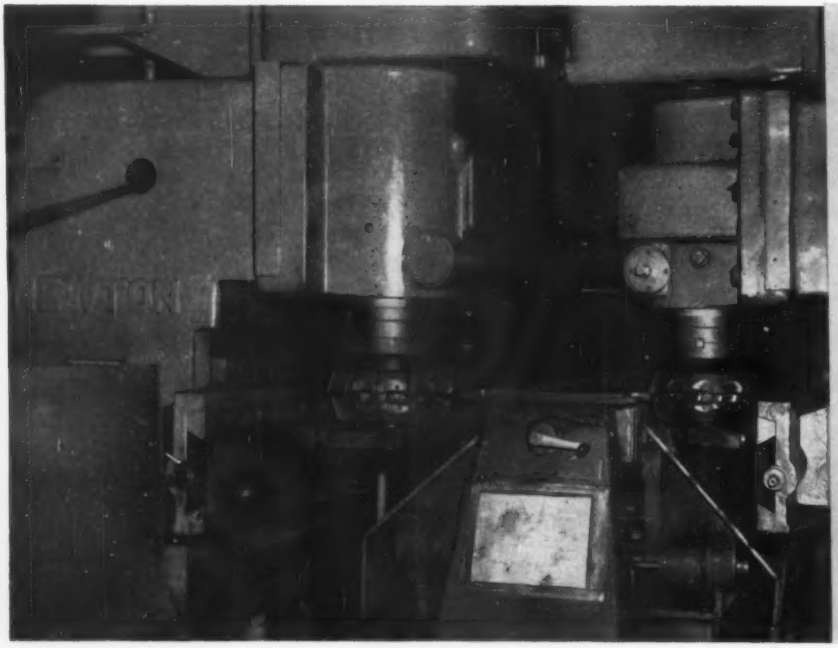


Fig. 2. Three carbide-tip inserted blade cutters on each tool-spindle mill five surfaces at the same time on opposite sides of the missile-launcher rails.

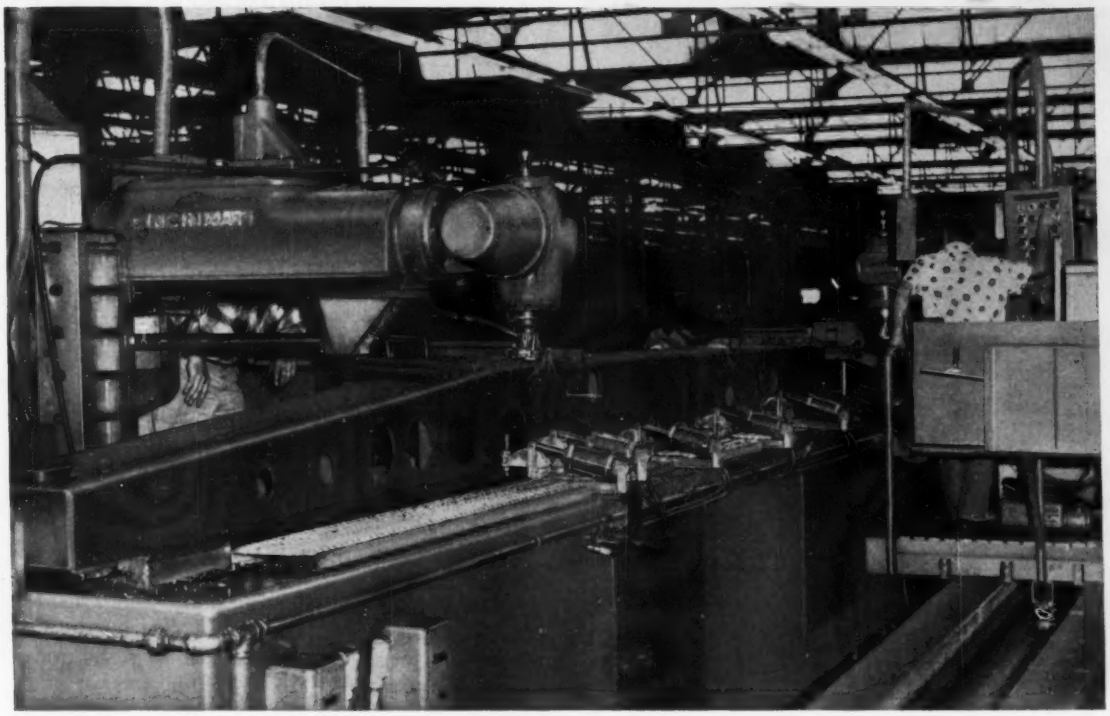
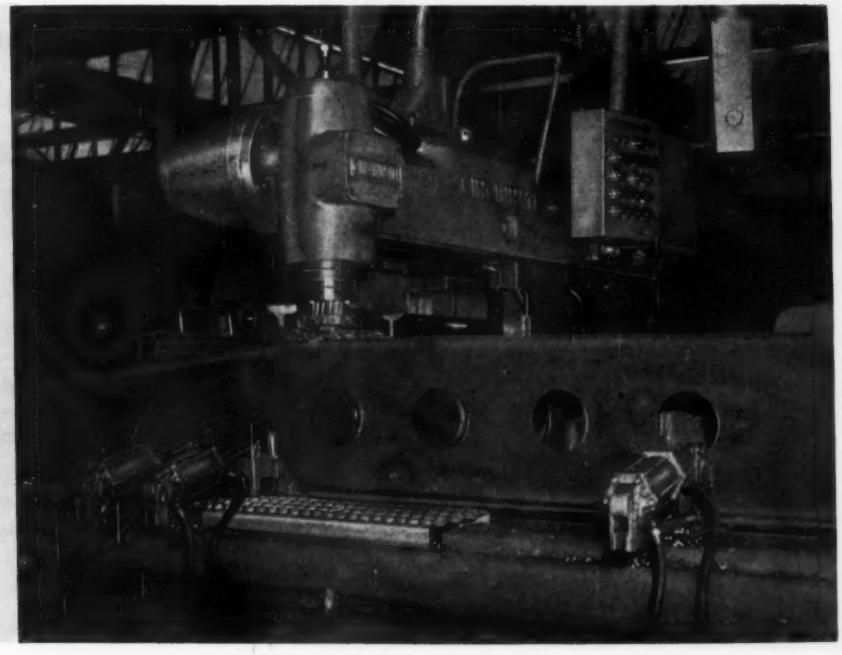


Fig. 3. Another big milling machine with two cutter-heads that rough and finish various surfaces on the bottom and ends of the long launcher rails.

Fig. 4 Close-up view of one of the tool-heads on machine in Fig. 3 which can be positioned at compound angles if necessary to provide wide versatility.



or longitudinally on the bottom of the rails. The rails are located from the surfaces finished on the previous machine, being held in position by hydraulic clamps.

Each milling head is mounted at the end of an arm that can be moved transversely by hydraulic power. The heads can be swiveled for taking cuts at compound angles. A close-up view of one cutter-head is presented in Fig. 4.

Four journals 8 inches in diameter are ground on big trunnions in a Van Norman cylindrical grinding machine. A close-up view of the 53-inch-diameter grinding wheel is presented in Fig. 6. The wheel is 3 1/2 inches wide and grinds the journals to specified size within plus 0.000 inch, minus 0.010 inch. Two of the journals are 5 1/2 inches long and the other two, 6 inches long.

The lower half of the main trunnion bearings are milled on the launcher frame (to receive the caps that hold the trunnion in its bearings) by a Hufford-built machine, of which a close-up view is shown in Fig. 7. There are two cutter spindles which successively take roughing and finishing cuts on both cap surfaces of the bearing lugs as the milling head feeds from left to right under hydraulic power. There are four sets of lugs. Drilling and tapping for the bearing studs and dowels are also accomplished on this machine. All machining is done at an angle of 40 degrees.

Three huge drilling, boring, and milling machines of ingenious design are used for performing a large variety of operations on the rocket-launcher base frame. The heading illustration shows one of these Giddings & Lewis machines for boring the four bearings and bearing caps of the trunnion housing at one end of the launcher frame. The long boring-bar with four sets of carbide cutters is adequately supported in bearings of the work fixture. Adjustable carbide cutters of the insert type are employed.

Rough and finish cuts are taken to bring the bearings to 9 inches in diameter within plus 0.006

Fig. 5. (Above) One of the horizontal milling units which is fed transversely in face-milling the ends of the long launcher rails.

Fig. 6. (Left) Four journals on large trunnion shafts are ground to size within close tolerances by the use of this machine.

Fig. 7. Six-spindle unit on a machine used for rough- and finish-milling the lugs of integral bearings on frames to receive bearing caps.

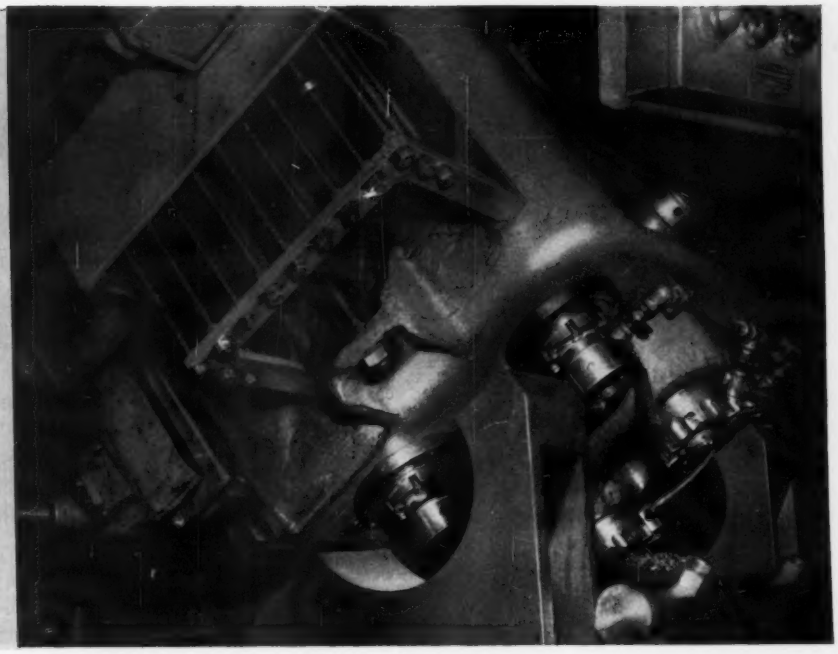
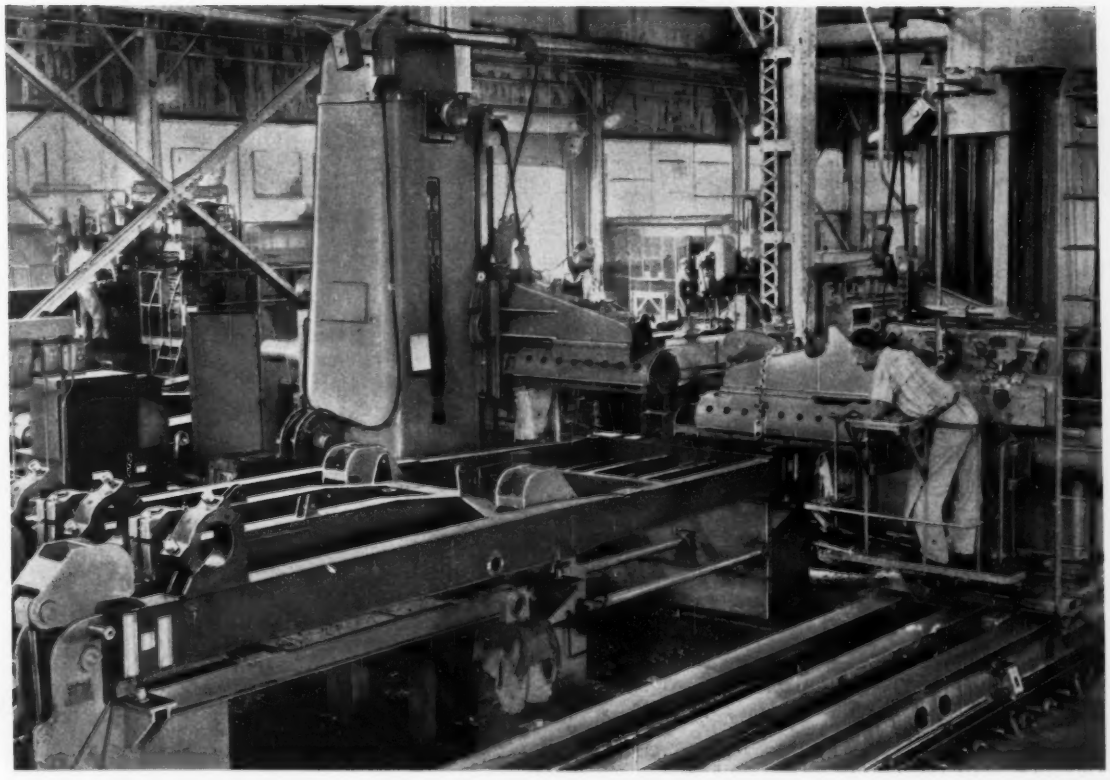


Fig. 8. Huge drilling, boring, and milling machine with auxiliary-head units that can be positioned as shown for certain face-milling operations or pulled out of way into vertical positions as seen in heading illustration.



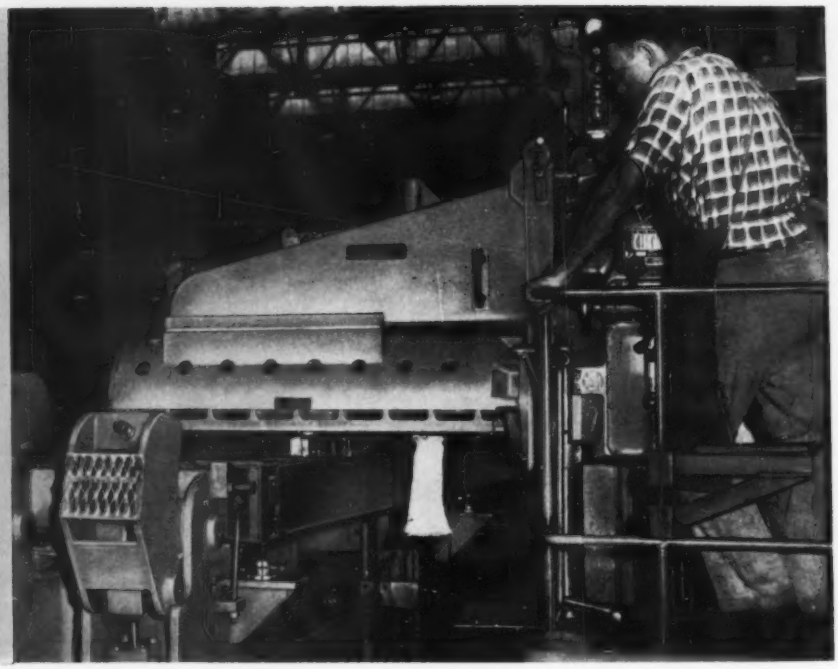


Fig. 9. Applying the auxiliary-head unit for a face-milling cut on a flat surface on top of a launcher frame.

inch, minus 0.000 inch. Use is made of a telescopic device to insure alignment of the rough bearings in setting up the job.

There are two columns on each machine as seen in Fig. 8 which are used independently of each other. For example, while the unit in the heading illustration was performing the boring job, the second unit was doing a milling job farther along the bed. The columns are moved along the bed by rack-and-pinion power and the heads can be fed vertically in the conventional manner.

A feature of these machines is the provision on each head of an auxiliary cutter over-arm for the face milling of horizontal surfaces. This auxiliary

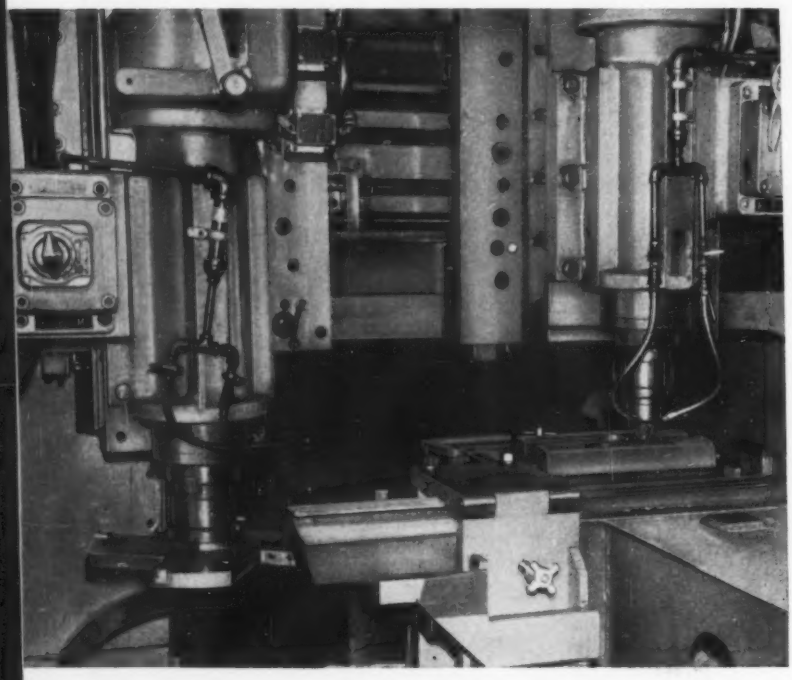


Fig. 10. While a large fly cutter of quadruple design at the left of this machine takes sweeping undercuts on the frame, a cutter on the right-hand head straddle-mills two vertical surfaces.

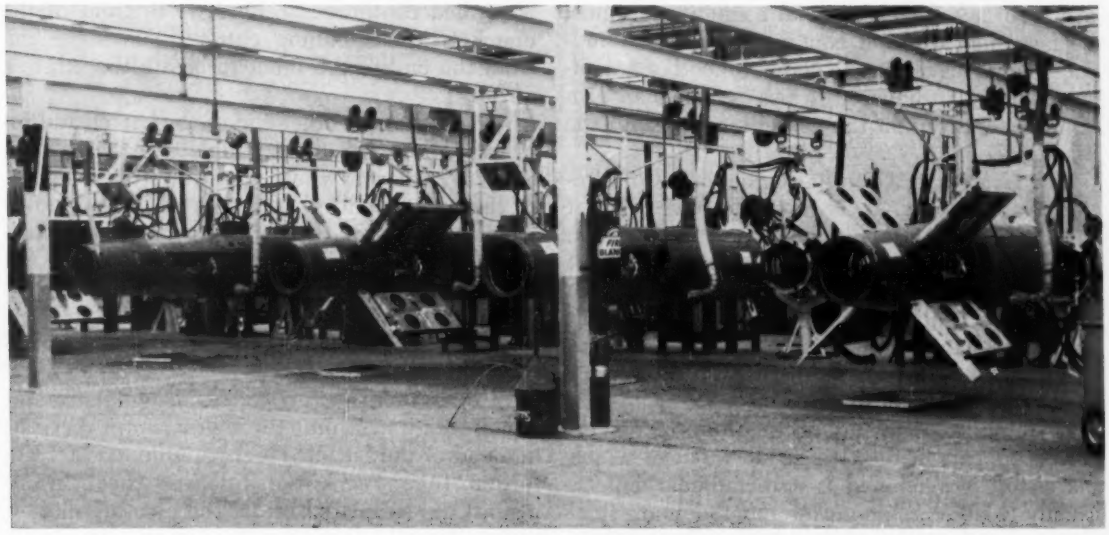
arm can be swiveled upward out of the way, as seen in the heading illustration, to permit the performance of boring and vertical surface milling. It can be quickly swung into the horizontal position and connected to the main cutter-spindle of the corresponding tool-head for taking face-milling cuts of the type shown in Fig. 9. The launcher frame is held in its fixture by hydraulic clamps located at intervals along the fixture. Four pads spaced across the frame are milled level in this setup within 0.010 inch.

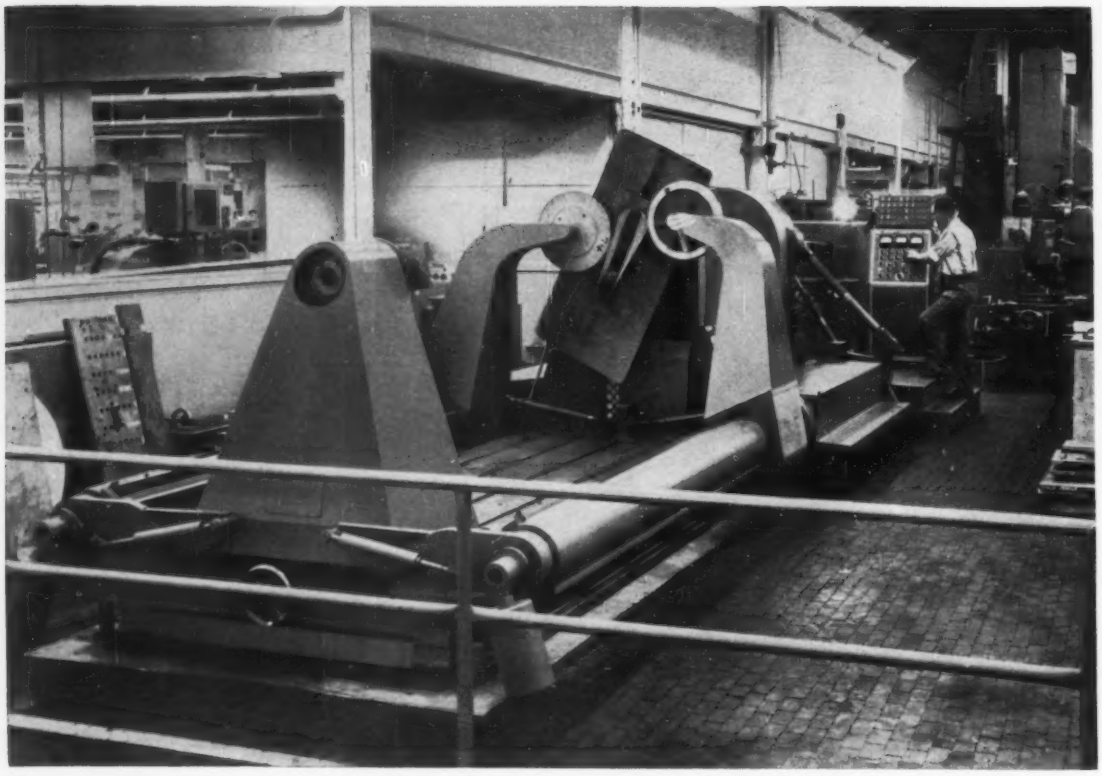
Three other huge machines equipped with two cutter-heads on a cross-rail, as seen in Fig. 10, perform a large variety of milling operations on the rocket-launcher erecting beam. The cross-rail housing moves along the bed of the machine in taking longitudinal cuts. In the operation illustrated the housing was stationary to permit a transverse straddle cut to be taken by a milling cutter on the right-hand head as it was fed transversely on the cross-rail. At the same time, a flat surface was being finished on the underside of the work by the large multiple, fly type cutter on the left-hand head. Four carbide-tipped cutter blades swing around a 24-inch circumference. At the time that the photograph was taken, a guard had been removed from around the cutter to give a clear view of the cutter details.

This article has dealt with operations in building ground-handling and launching equipment for Nike-Hercules guided missiles. These operations are confined to two shops of the plant. Other shops are engaged in some unusual jobs for the atomic-power field, and in other more prosaic activities.

One of the features of this plant is the program of continuously modernizing and expanding facilities. A twenty-year performance forecast is maintained on all equipment. Machines are replaced before they wear out or become obsolete.

After partial assembly of the aft portion of the surface-to-air Nike-Hercules missile, it is transferred to this highly classified area at the Charlotte, N.C., Division of the Douglas Aircraft Co., Inc. At this point, test fins are linked to the control section, which is thoroughly wrung out under simulated flight conditions.





HUGE PANTOGRAPH DOMINATES

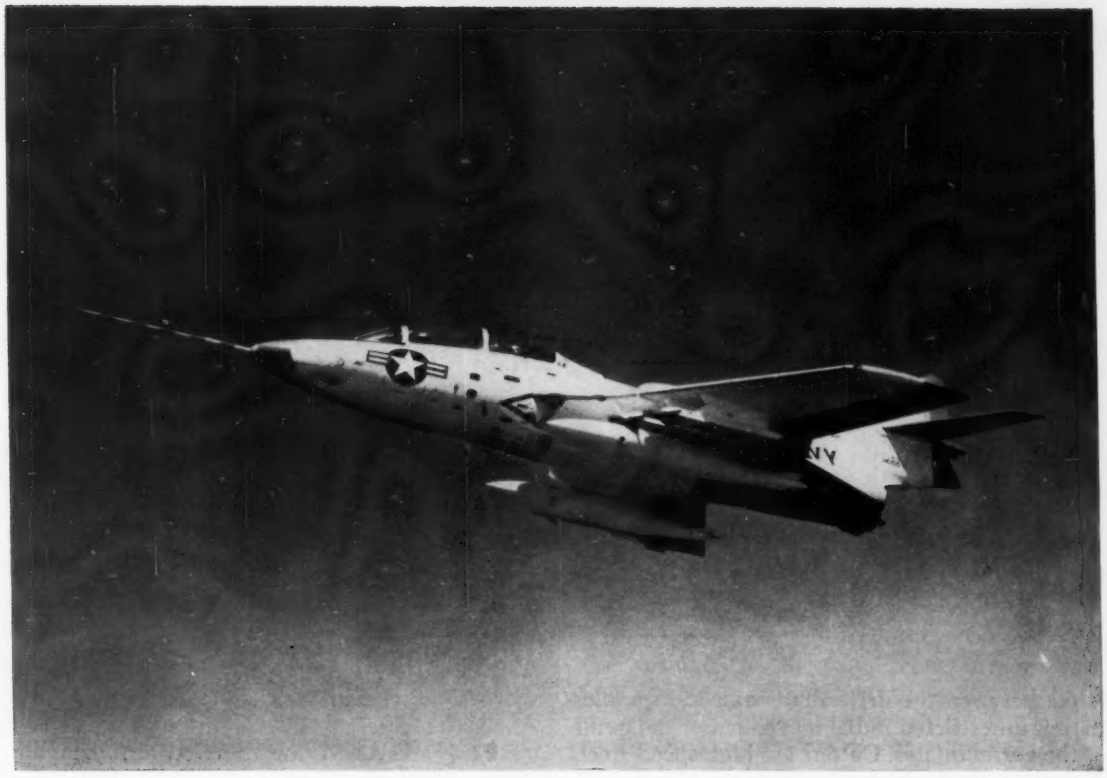
BEFORE an airplane prototype is built, its performance is studied in extensive wind-tunnel tests of a small model. For the tests to be reliable, every surface of the external configuration must be fashioned to exact contour and scale. Wind-tunnel charges run in the neighborhood of a thousand dollars an hour, so it also becomes an economic necessity that the model be precise to the nth degree.

The Grumman Aircraft Engineering Corporation, Bethpage, N. Y., is proud to have what it considers one of the topnotch model shops in the airframe industry. A focal point of interest in this shop is the Whaley airfoil milling machine seen in the heading illustration. The equipment employs a pantograph principle to produce laboratory models of wing sections and other airfoils to close dimensional tolerances.

A simplified drawing of the movements involved appears in Fig. 1. The stock out of which the airfoil is machined is a rectangular billet—usually 4340 chrome-nickel molybdenum steel heat-treated to 38 to 42 Rockwell C—which is contained in a slow-rotating barrel. One end of the barrel carries a chuck through which the stock is pushed continuously. Directly in front of the chuck is a face-milling cutter, removing metal from the end of the billet to create the finished airfoil.

Attached to the other end of the barrel, and rotating with it, is a 4-to-1 template of the finished airfoil. A follower-wheel, four times the diameter of the milling cutter, is supported on a bracket which feeds along the periphery of the template by means of a ball screw. At its bottom, the bracket is splined to a hydraulically loaded torque tube. Pinned to the front end of this torque tube is a mechanical linkage to the milling-cutter quill.

In operation, the stock, barrel, template, and chuck rotate as a unit through a worm drive at one end of the barrel. The hydraulic load on the torque tube keeps the follower-wheel firmly against the template, so that the pivoting motion



GRUMMAN MODEL SHOP

EDGAR ALTHOLZ
Associate Editor

of the follower-wheel bracket, as controlled by the cross-sectional configuration of the template, is translated into a corresponding motion of the milling-cutter quill.

While the ball screw is feeding the follower-wheel bracket axially along the template and torque tube, the stock is pushed forward through the chuck. This is done by another ball-screw system, next to the barrel. The jaws in the chuck are carefully adjusted to exert just enough squeeze to have the stock resist the cutting thrust and are still free enough to permit the forward feed of the stock.

To explain the motions of the Whaley machine, the drawing (Fig. 1) has been simplified to show only one cutter, torque tube, and follower-wheel. Actually, as can be seen in some of the other accompanying illustrations, there are duplicate arrangements of these elements on both sides of the machine, for roughing and finishing. The diameter of the follower-wheel of the roughing cutter is oversize. Axially, the roughing cutter and its follower-wheel are set slightly ahead of the finishing cutter and its wheel.

Again, while the drawing shows the use of a three-dimensional template for a tapered-section airfoil, the equipment is often used with a two-dimensional template (as in the heading illustration) for a constant-section airfoil. In the first instance, the three-dimensional template is supported from a tailstock, Fig. 2. This member is set along the machine bed at a point where a flange on the template can be bolted to a faceplate on the end of the barrel.

In the second instance, where a two-dimensional template is used, it is supported solely on the faceplate, as in Fig. 3. Here, the follower-wheels are aligned with the template, and the ball-screw feeds of the follower-wheel brackets are disconnected.

A close-up view of the chuck and cutter section appears in Fig. 4. In the foreground are two drive-shafts which extend from a common transmission box to the cutter-spindles. Universal

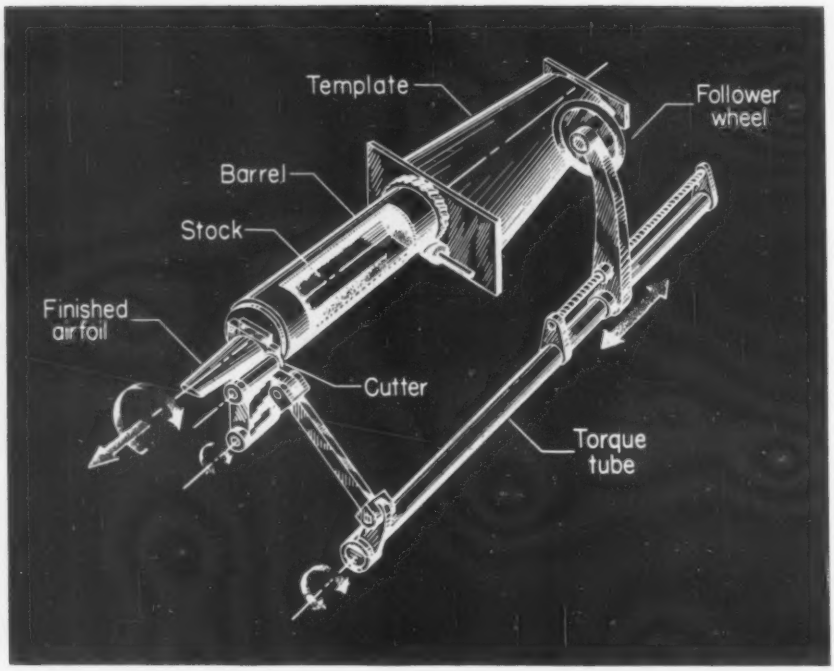


Fig. 1. The Whaley pantograph principle employs three-dimensional templates to produce tapered airfoils. Two-dimensional templates for straight airfoils are also used. Actual machine has two follower-wheels, torque tubes, and cutters.

joints between the drive-shafts and the spindles permit unrestricted radial movement of the quills as the barrel rotates. Cutters are high-speed steel, insert type, and 6 inches in diameter. Those used for finishing have twelve to twenty-four teeth; those for roughing, eight to twelve teeth. The chuck has four independently adjustable jaws, two wide and two narrow, to conform to the rectangular cross-section of the work billet. As previously explained, the required airfoil profile is produced as the stock advances out of the jaws into the paths of the cutters.

When the stock, with its sides previously machined square and parallel, is first fed through the jaws, the work is left in its original, rectangular cross-section for a distance of about 1 inch before the cutters are brought in and machining starts. This area is used for locating the airfoil in fixtures for subsequent operations. It is cut off in the final stages of the model preparation.

Details of the pantograph linkage to the cutter appear in Fig. 5. A connecting-rod joins the front of the torque tube (not shown) with a pivoting block which contains the cutter-spindle quill. Beneath the connecting-rod is a hydraulic cylinder which exerts pressure on the pivoting block, keeping the cutter in contact with the work and the follower-wheel in contact with the template.

Another feature of the equipment is the provision for feeding the stock. Around the barrel is a carriage, seen in Fig. 6, which is gibbed to ways along each side of the barrel. Ball screws advance

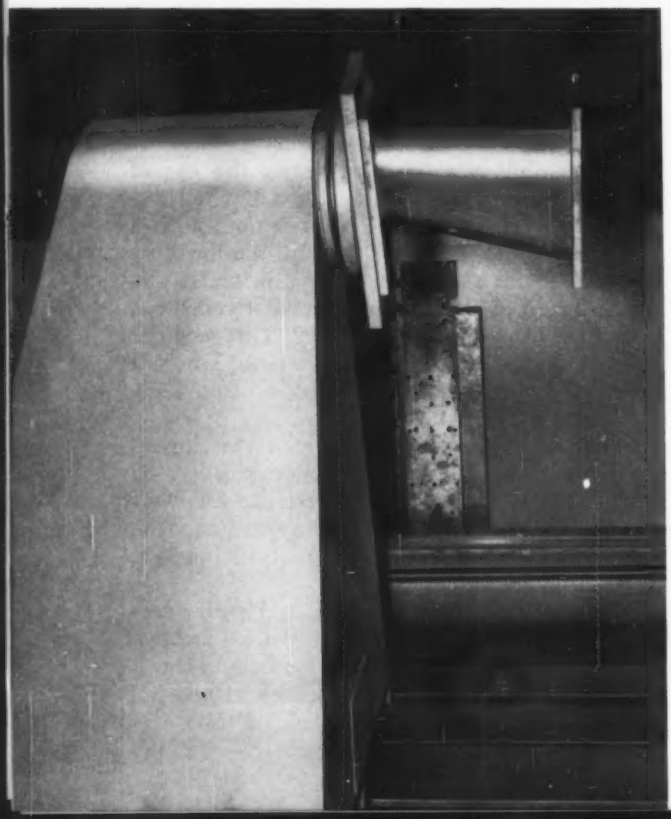


Fig. 2. Large tailstock holds template on machine center line for three-dimensional work. In use, tailstock is moved forward and front flange on template is bolted to faceplate on rear end of barrel. Template is free to rotate in its tailstock bearing.

Fig. 3. (Right) Two follower-wheels control the roughing and finishing cutters. Template has four times the chord and thickness of airfoil, plus a 2-inch "rind." Rind permits thin airfoil sections to be made without template distortion.

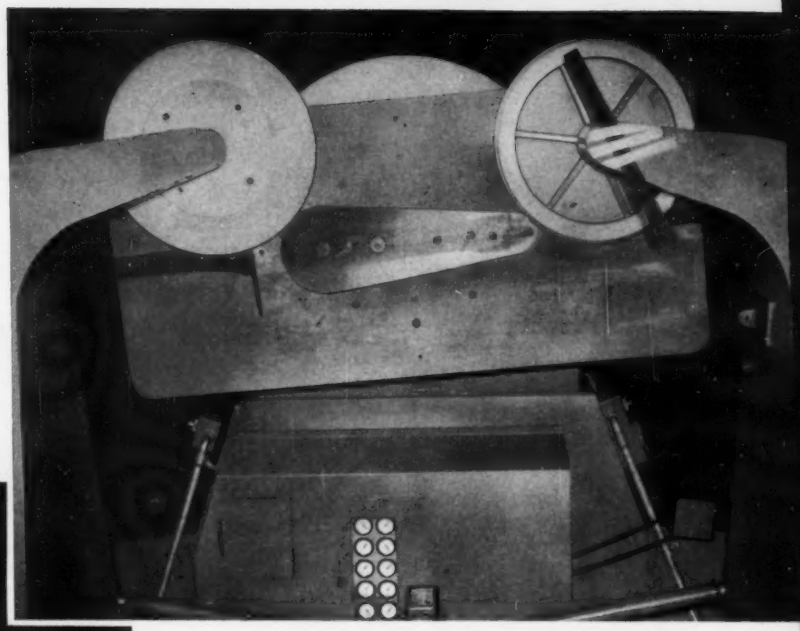


Fig. 4. (Below) Billet becomes an airfoil as it emerges from chuck into the paths of cutters. Stock capacity of machine is from 1 by 4 inches to 6 by 14 inches, with maximum length of 83 inches. A carriage on headstock prevents long airfoils from drooping.

the carriage over the ways. There are two open channel areas, 180 degrees apart, in the barrel wall. The carriage is lined with a circular bearing to which is fastened a cross-member which extends through the two channel areas.

This cross-member is the actual stock pusher. Before positioning the airfoil stock in the barrel, the end of the material is drilled, counterbored, and tapped centrally. In the barrel, a shouldered cap-screw in the middle of the cross-member engages the end of the material, thus keeping it parallel to the machine axis. When the stock and barrel rotate, the cross-member and the circular bearing turn with them. Meanwhile, the feed system rotates the ball screws, causing the carriage

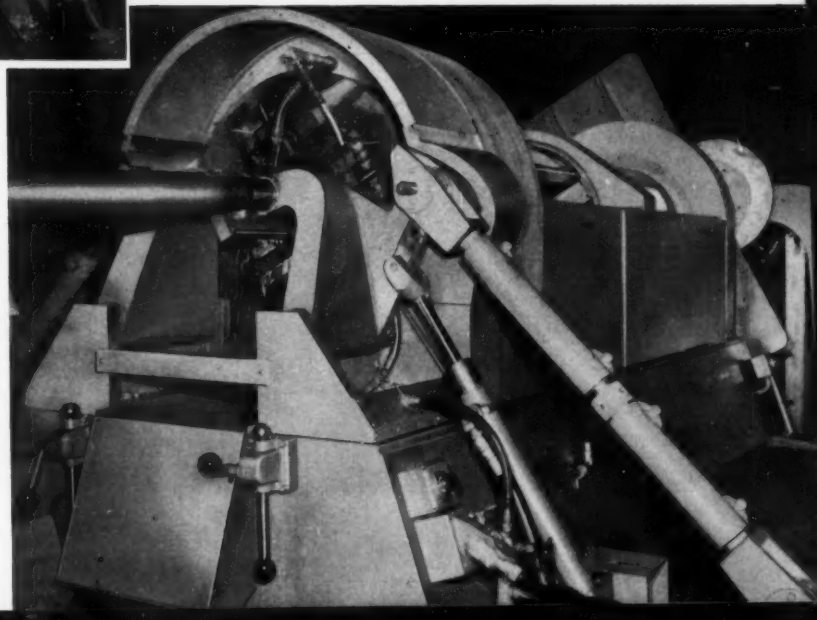


Fig. 5. As barrel rotates, radial movement of the follower-wheel seen at rear end of barrel is translated to large connecting-rod in foreground via torque tube. Normally, cutters climb-mill with barrel rotating continuously. Barrel can also be made to oscillate if follower-wheel cannot clear a concave surface on a template.

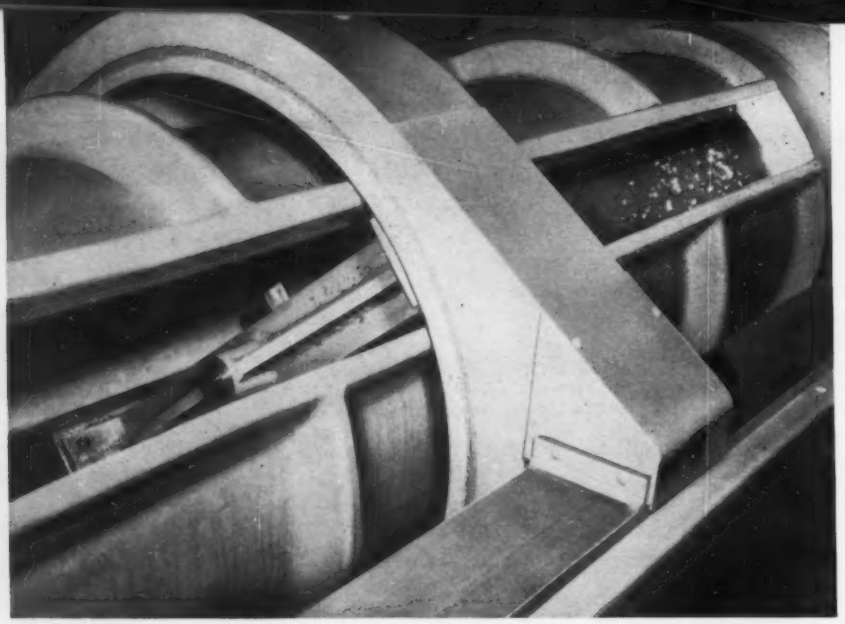


Fig. 6. Feed carriage, containing inner circular bearing and cross-member, or stock pusher, advances over ways as barrel rotates. Cross-member is made to rotate with barrel by cam follower running in longitudinal slot in outside of barrel.

to advance on the ways. The circular bearing, retained in the carriage, advances with it, and the cross-member pushes the stock ahead in the barrel and out through the jaws.

In addition to the milling of airfoils for models, the Whaley machine has also been put to work in developing Grumman's new hydrofoil seacraft. A two-dimensional template and the hydrofoil rudder section produced from it are shown in Fig. 7.

Some of the two-dimensional templates for the Whaley machine and many small, irregular parts such as cams are speedily constructed on the equipment seen in Fig. 8. This is a New England template and cam machine. It works directly from an enlarged line drawing or aluminum-foil cutout. The enlargement ratio is optional—as much as 20-to-1, or higher—with any errors in the drawing or cutout reduced in the same ratio at the milling cutter.

The illustration shows the large tracing table of the equipment in the foreground. In this instance, it is used to produce a butterfly cam for the nosewheel gear of Grumman's new Gulf-

Fig. 7. Hydrofoil seacraft under Grumman development for Office of Naval Research are revolutionary concepts in boat design. Whaley machine produces foil section of rudders, one of which is shown with its template.

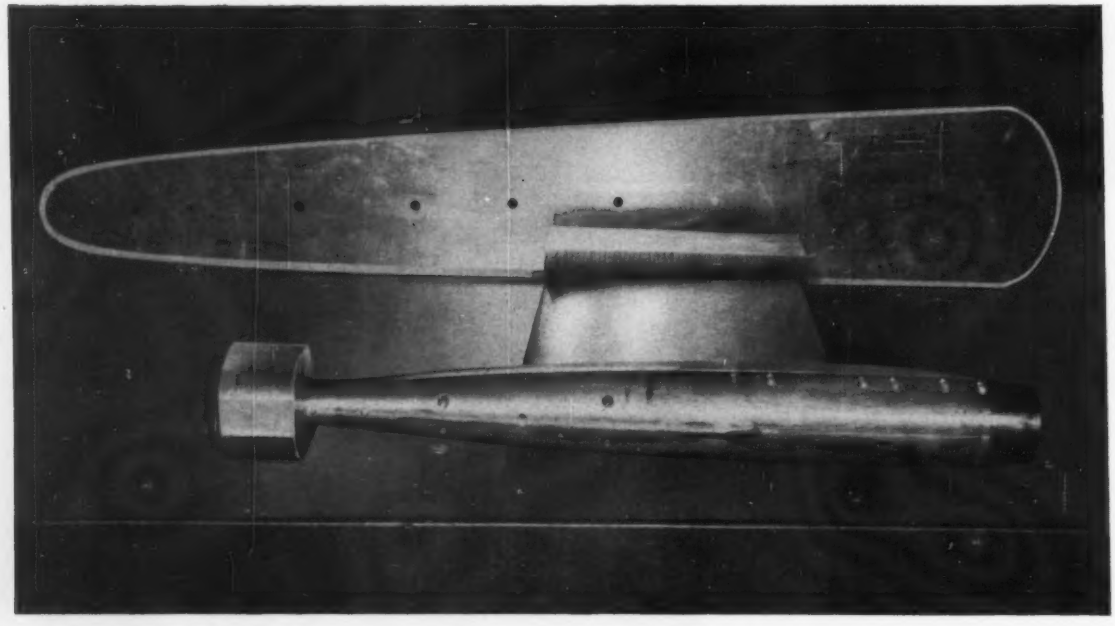


Fig. 8. Large, insulated tracing table is important part of the template and cam machine. Non-contacting stylus follows aluminum-foil cutout as table rotates, actuating cross-slide carrying cutter-spindle and motor.

stream executive airplane. The 20-to-1 scale cutout is shown in oriented position on the table, with one of the finished cams for size comparison. A tracer-slide moves radially in and out over the table, and actuates a cross-slide at right angles to it, which carries the cutter-spindle and motor. This second slide, in turn, moves radially over a smaller table on which the work-piece is mounted. Both tables are geared together, rotating at the same speed.

The tracer-slide is equipped with a disc stylus which bears the same diametral relationship to the milling cutter (in this instance, a scale of 20-to-1) as does the cutout to the work-piece.

As the tables revolve, the stylus follows the edge of the cutout without ever touching it. This is done by an electronic control system which utilizes a high-tension spark gap of low amperage. (The cutout must be of an electrically conductive material. If a line drawing is used, it must be made with a metallic ink.) The movement of the tracer-slide is duplicated, in appropriate reduction, in the movement of the cross-slide.

A close-up view of the work-table and spindle appears in Fig. 9. The spindle has a broad speed range—48 to 11,500 rpm—so it can be used with a small grinding wheel as well as with a profiling cutter.

Fig. 9. Close-up view of cutter-spindle and work-table showing cam profiled from the cutout seen on tracing table in Fig. 8. The cross-slide follows ratio bar mounted on tracing table slide.

NORTRONICS TOOLS UP FOR

Careful planning achieved manufacturing flexibility in evolving from research and development to a volume-production basis on an important Army ballistic missile

HARRY F. CROSS
Director of Industrial Engineering
Nortronics Division, Northrop Corporation

SEVERAL million dollars worth of machine tools have recently been installed in the Anaheim, Calif., plant of the Nortronics Division of the Northrop Corporation to provide facilities for quantity manufacture of components for Hawk surface-to-air missiles. The concern is a major subcontractor of United States Army Weapons. The project dates from late 1954, when the company was charged with design and engineering responsibilities for airframe structural components and related mechanical ground-support equipment. These include the mobile, triple launcher; self-propelled loading vehicle; and missile-storage pallet. The manufacture of research and development models and follow-on production was a concurrent responsibility.

During the first three years of participation in the project, production rates were relatively low, due to the Army's awaiting the results of systems-compatibility and performance-reliability tests. Standard type machine tools and equipment were able to meet manufacturing requirements. Relatively few drill jigs or special lathe and milling machine fixtures were necessary.

Manufacturing concepts had to be changed more recently as satisfactory tests led to the placing of substantial orders for the varied Hawk missile components. The latest contract calls for $22,000,000 worth of ground-support equipment and airframes. Obviously, several significant manufacturing challenges resulted and have been met by the acquisition of more machine tools and other manufacturing equipment.

The wings and elevons of Hawk missiles are constructed of bonded-aluminum skin and honeycomb core, and forged-aluminum fittings. The missile airframe includes magnesium castings, internal aluminum forgings for the hydraulic system, magnesium extruded tunnels (attached externally), and aluminum skins and extrusions.

Components of ground-support equipment include several large, hollow aluminum castings for the main structural members and steel sheets and tubing which require welding and finishing operations. Some of the launcher parts are as large as 41 inches in diameter. The aluminum castings range up to 2 by 3 by 5 feet in size. Tolerances as close as plus 0.0005 inch must be met on some parts.

In planning production-line techniques for both manufacture and assembly, it was necessary to take into account the fact that design changes are an inherent part of a manufacturing task on products as new as missiles. In order to exert strict control over costs and quality, careful preplanning was essential. The decision was reached to establish the manufacturing program around conventional machinery, rather than specially designed equipment, and augment the conventional equipment with Nortronics-designed tools and fixtures. Implementation of the plan required the acquisition of approximately 120 additional machine tools. Operations on some of these machines will be here described.

The somewhat complicated steel weldment seen on the DeVlieg Spiramatic Jigmil in Fig. 1 required a rather elaborate fixture in drilling and boring bearing holes through two arms. These holes, 1.375 inches in diameter, must be machined in line within plus 0.001 minus 0.000 inch. The arms are 20 inches apart.

In setting up this loader link assembly in the fixture, it is positioned lengthwise by inserting plugs in previously finished holes at the opposite end of the part. Correct height of the arms to be drilled and bored is assured by resting the arms on locating pads on the fixture. It will be observed that the fixture base is provided with eyebolts to enable quick loading on the machine table by means of a hoist. This arrangement also

HAWK MISSILE PRODUCTION

facilitates removal when a different job is assigned to the machine.

The four-spindle Gorton machine illustrated in Fig. 2 is being used for profile-milling mounting lugs simultaneously on two actuating sections of the missile support mechanism. Three separate templates are necessary to complete each part. These templates are used in conjunction with a True-Trace attachment to guide the tools around comparatively complicated paths.

There is a total of sixteen mounting lugs on each actuating section arranged in pairs. They must be finished within an exceptionally close tolerance to insure satisfactory attachment of four hydraulic cylinder bodies that are mounted on each actuating section. This part is made of magnesium. Accurate drilling and boring of a variety of components is a prime requisite. Operations of this category are performed on various types of machine tools. For example, Fig. 3 shows an Ex-Cell-O double-end precision drilling and boring machine engaged in roughing and finishing holes 2 5/8 inches in diameter in line in the actuating section. There are two sets of these holes, or four holes altogether. At the same time that the holes are being bored, a ring groove is generated in each bore by a retractable grooving tool that is incorporated in the corresponding boring-bar.

At the front of the work fixture there is a Keller air-fed drill which produces a relief hole of 7/8-inch diameter at one point around the periphery of each larger bore. These holes can be clearly seen on the parts stocked to the right of the machine in Fig. 2. The fixture is of an indexing design to permit indexing through 180 degrees for line-boring the large holes and through 90 degrees to locate the work for drilling the relief holes.

A lower azimuth drive housing for the Hawk launcher is seen having a series of holes finished on a Heald Bore-Matic in Fig. 4. Four holes ranging from 1.250 to 1.750 inches in diameter are finished in this operation within plus 0.0005 inch, minus 0.0000 inch. The tolerance on the center-to-center distance between the holes is plus 0.001 inch, minus 0.000 inch. This part is an aluminum casting.

Fig. 1. (Right) Machine tools of modern design have been installed at the Anaheim, Calif., plant of Nortronics for the production of components of Hawk missile and ground-support equipment.

Fig. 2. (Left) Four-spindle profiling machine which finishes sixteen mounting lugs around a missile-launcher part to receive four cylinder bodies.

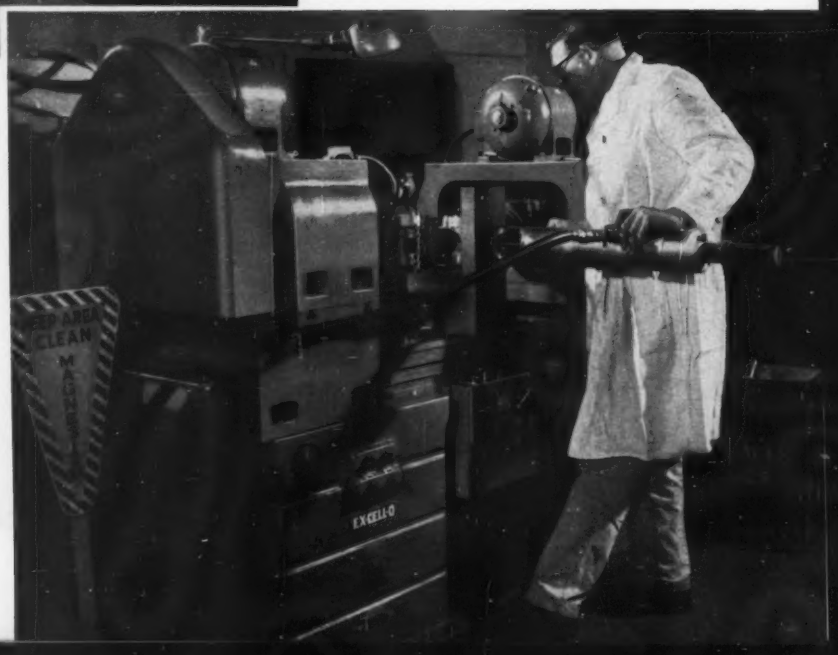


Fig. 3. (Right) Precision boring operation on an actuating section which includes the use of an air drill at front of work fixture for drilling four relief holes.

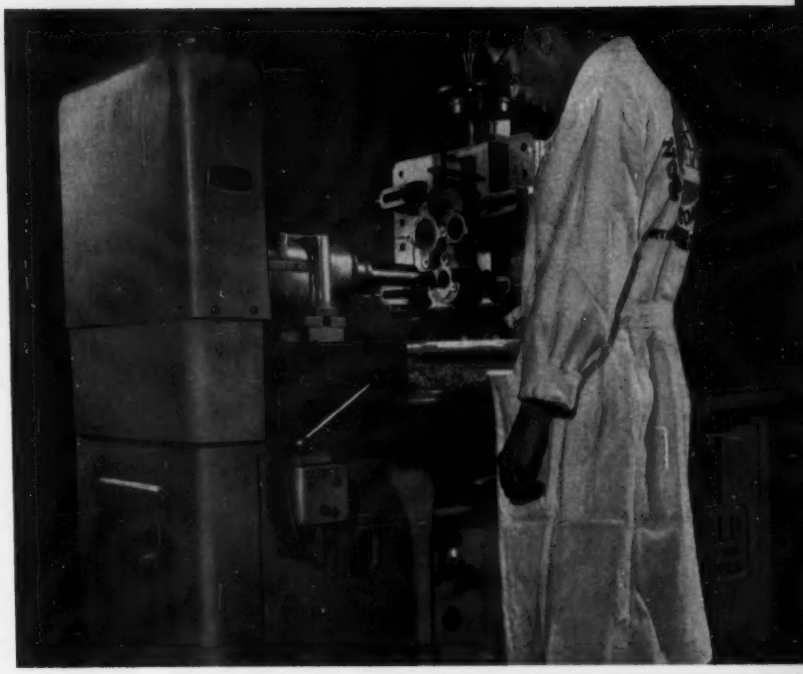


Fig. 4. Precision boring four holes in a lower azimuth drive housing for a Hawk missile launcher. Tolerance on the diameter of the various holes bored is plus 0.0005 inch, minus 0.0000 inch.

Jig-boring machines are enclosed in an air-conditioned room to insure consistent dimensional accuracy on the work. Fig. 5, for example, shows a Sip Hydroptic jig-boring machine in this department engaged in precision boring holes in a drill bushing plate. This plate will be attached to a jig for accurate duplication of a Hawk loader part.

Another machine in the air-conditioned room is the Pratt & Whitney jig borer shown in Fig. 6. It is seen engaged in boring a jig that will be employed in drilling, reaming, and spot-facing a trunnion shaft for the launcher boom. The jig is of an indexing design and is constructed largely of steel plate.

Radial drilling machines are used rather widely because of their versatility on a variety of parts and for taking different types of cuts. In Fig. 7, for example, is shown a Carlton machine with a 19-inch column and a 6-foot arm being used for boring and reaming a hole of 2.500 inches diameter to size within plus 0.0014 inch, minus 0.0000 inch in the azimuth support ring base of the Hawk launcher. This part is an aluminum casting.

In the same operation a hole is drilled and tapped to 1 1/2 inches, 12 threads per inch. Both holes are produced at an angle of 13 degrees from the vertical center line of the part through the use of a tilting table. Graduations on the

Fig. 5. Assurance of accurate jigs and fixtures for quantity production operations is obtained by using jig-boring machines in an air-conditioned room.

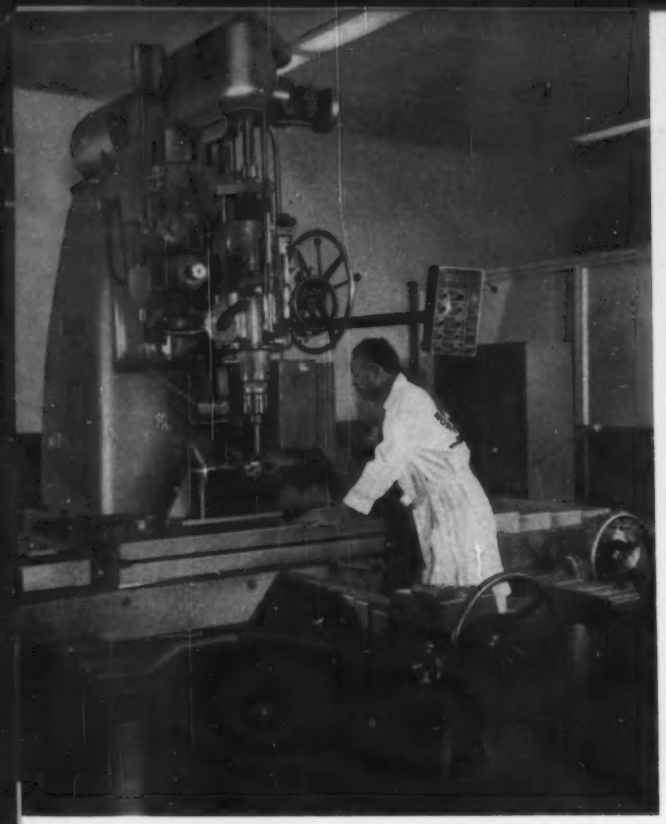


Fig. 6. Another jig-boring machine being utilized in making a jig for drilling, reaming, and spot-facing cuts on a launcher-boom trunnion shaft.

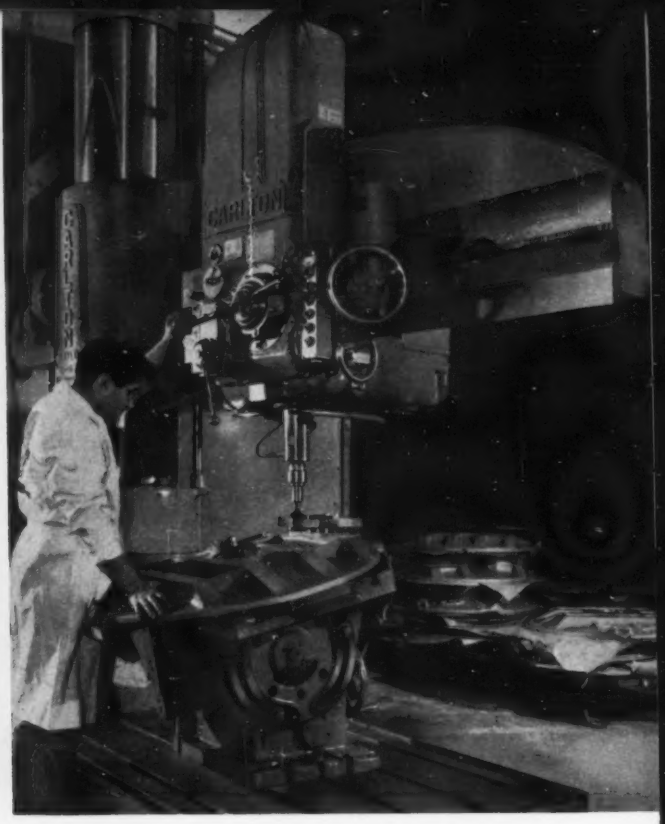


Fig. 7. Applying a radial drilling machine equipped with a tilting table for boring and reaming one hole and drilling and tapping another on a large part.

table insure accurate settings when operations of this sort are performed.

Lathes are also important in a missile plant as indicated by Fig. 8, which shows a Sidney engine lathe equipped with a Sidney fluid tracer for duplication of parts on a production basis. The particular operation illustrated consists of turning a boom trunnion shaft to about eight different diameters of various lengths. A trunnion shaft that was previously turned to the specified dimensions is used as a pattern for actuating the stylus of the tracer unit as the stylus is moved longitudinally along the master with the feeding movement of the carriage. In-and-out movements

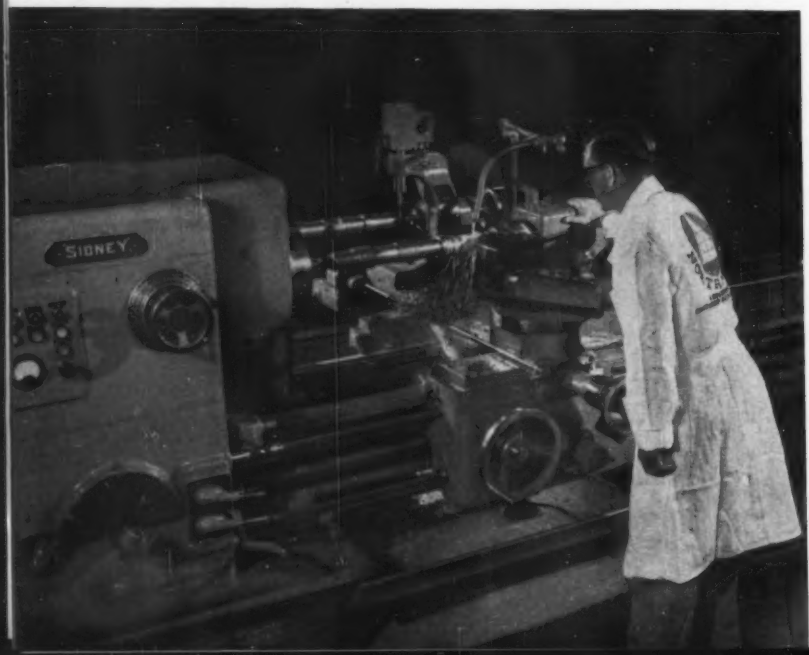


Fig. 8. Lathe operation in which duplication of parts is assured by the use of a fluid tracer of which the stylus moves longitudinally over a similar part that has been machined to close accuracy.

Fig. 9. Performing drilling and boring cuts on a main-boom box casting which is 60 inches in length. The part is cast from aluminum.

of the stylus are, of course, imparted to the tool-slide and the tool. The shaft is made of steel. A carbide-tipped cutter is used.

The main-boom box casting for the launcher has a number of holes that must be drilled and bored to close center distances. Such an operation is seen in Fig. 9 being done on a Giddings & Lewis drilling, boring, and milling machine of the horizontal type. This part is cast from aluminum. It is approximately 60 inches long.

Profile-milling on a production basis is typified by an operation in which four main wing fittings for the missile are milled simultaneously on a four-spindle Cincinnati Hydro-Tel. The path of the cutters is guided by the stylus of the tracer unit at the right-hand end of the table as it moves around and over the configurations of the template. A pocket milled in this operation is held to a close tolerance to insure perfect bonding of the wing honeycomb section to the fitting.

Vertical boring mills are used for turning, boring, and facing parts of large diameter. A typical operation is shown in Fig. 10 being performed on a 56-inch Bullard vertical turret lathe. The part is an azimuth bearing-support ring cast of aluminum. After being turned and bored, it is faced top and bottom to the specified thickness within 0.005 inch, plus or minus.

Through the application of modern machine tools, as here outlined, the goals originally set by the Nortronics management have been attained. They were, primarily, minimum shop rearrangement, flexibility of operation, and optimum-cost performance on a volume production basis.

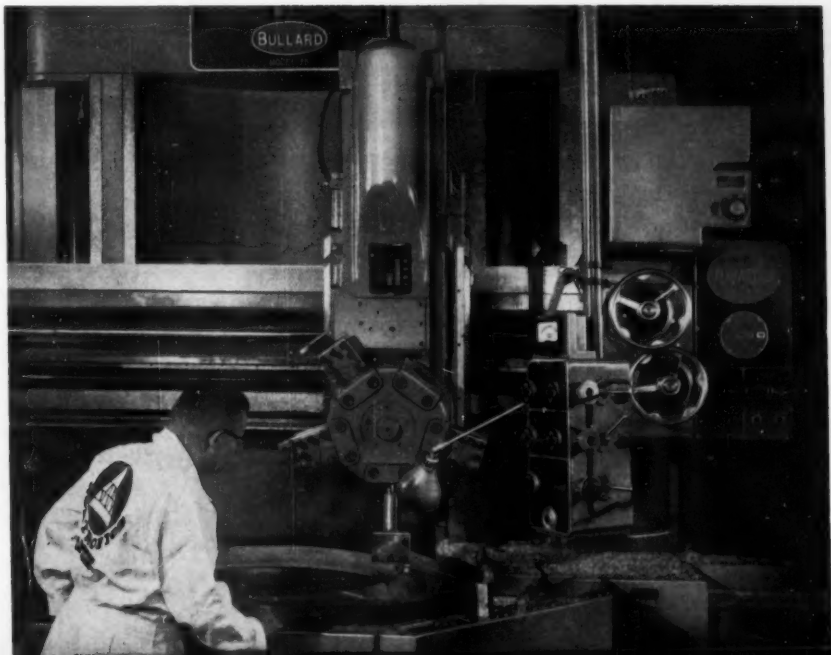


Fig. 10. Turning, boring, and facing cuts are taken on large circular components by vertical boring mills. A thickness tolerance of 0.005 inch is specified on the particular job illustrated.

KEARFOTT'S METHODS

Immaculate assembly facilities and versatile machining methods enable Kearfott to keep pace with the ever-increasing precision required in the field of missile and aircraft control. Tolerances on system components are often specified in millionths of an inch

HAROLD W. BREDIN
Associate Editor

INERTIAL GUIDANCE SYSTEMS, three-gyro stable reference platforms, and servo components for missile and aircraft applications are typical products of the Kearfott Company, Inc., Little Falls, N. J. Over the last ten years this company, a subsidiary of the General Precision Equipment Corporation, has collaborated with various government agencies in the development of airborne control and navigation systems. Recent activities include research and development on the ways and means of space navigation.

Servo systems for control applications in missiles and jet aircraft must have a high degree of precision and reliability. Included among the many components the company produces for use in its own systems and those of other companies are various types and sizes of synchros. Basically, synchros are self-synchronizing motors often used

to transmit electrically the angular displacement of a shaft and mechanically reproduce this displacement at a remote or other more convenient location. Certain synchros made by the company operate so precisely that the maximum error is only 20 seconds of arc. Such accuracy is made possible by maintaining very close tolerances on size and concentricity during machining.

An unusual form-grinding operation is performed on synchro rotors of the type illustrated in Fig. 1. The slip rings at the right-hand end of this rotor are made of 14-carat gold and are embedded in plastic. V-grooves 0.010 inch deep and 0.010 inch wide are required in these slip rings to accommodate gold-wire brushes 0.012 inch in diameter. In addition, a 6-micro-inch finish is specified for the slip rings.

The periphery of the entire slip-ring assembly, including both the plastic and gold surfaces, is form-ground in one operation. This is done in a Sheffield grinding machine without excessively loading the crush-formed wheel. The medium-grade, open-structure wheel used is made of 450-grit aluminum oxide held in a vitrified bond and is operated at a speed of 3800 sfpm (surface feet per minute). A tolerance of 0.0003 inch is maintained on both the diameter and concentricity. For grinding, the rotors are positioned by their journals in the V-grooves of a special fixture. Spring-loaded members retain the rotor during the operations. This method of machining synchro slip rings was recently adopted and has increased

KEEP MISSILES ON COURSE

production from approximately fifteen to sixty rotors per hour.

Synchro stator housings and end caps are both initially machined from stainless steel in Warner & Swasey multiple-spindle bar automatics. The periphery of the housing is then ground to within a total tolerance of 0.0005 inch in a Cincinnati centerless grinding machine and this surface is used to accurately locate the component during subsequent machining. After several additional facing, turning, and drilling operations, the stator assembly and other minor parts are inserted in the housing. Next, the end cap is installed and the edge of the housing is spun over the outer edge of the cap. Thermosetting resin is used to impregnate and seal the assembly. A completed housing and stator assembly is seen in Fig. 2.

The stator assembly consists of a stack of stamped laminations having a 0.0005-inch tolerance on the periphery and a much looser tolerance on the center hole. These laminations are machined in line with the bore of the end cap and housing. This is accomplished by rough- and finish-honing the assembly in the Micromatic honing machines seen in Fig. 3. For these operations, the assembly is located by the periphery of the housing in a special indexing fixture. The total tolerance on the bored diameter after honing is 0.0003 inch. Sheffield Precisionaire gages provide a convenient means of checking the parts at the machine.

After burrs are removed by wire brushing, a Sunnen hone is used to bring the bores of both the end cap and housing to final size. The bore diameters are specified to 0.00005 inch, and the total tolerance is 0.0001 inch. In addition, the bores must be straight and round within 0.00005 inch, full indicator reading. Air gages are used to inspect the work-pieces for these requirements. Machining of the housing and stator assembly is completed by facing and turning the synchro's mounting surfaces (locating the part by means of the honed bore) and milling a key slot.

Servo and guidance devices for use in missiles are almost constantly being redesigned. This fact has led Kearfott to employ locating fixtures only where their use is unavoidable. Often, a locating surface (sometimes an otherwise functionally unimportant one) is machined to a very close tolerance and the part is accurately positioned by gripping it on this surface in a diaphragm chuck for several machining operations. In Fig. 4 the bore of an instrument held in a diaphragm chuck is being ground in a Bryant grinding machine.

Generally, as many operations as possible are performed in a single chucking. For this reason, a large number of parts are initially machined in automatic screw machines of which the Swiss type automatic illustrated in Fig. 5 is typical. The housings of synchros and other servo system components are often very thin and cannot be chucked in the conventional manner without deforming the part. Grease-actuated, expanding type chucks have been employed to prevent deformation in such cases.

Ballizing is used as a means to size certain holes in parts to within 0.000025 inch. These holes are first bored to a 0.0003-inch tolerance with be-

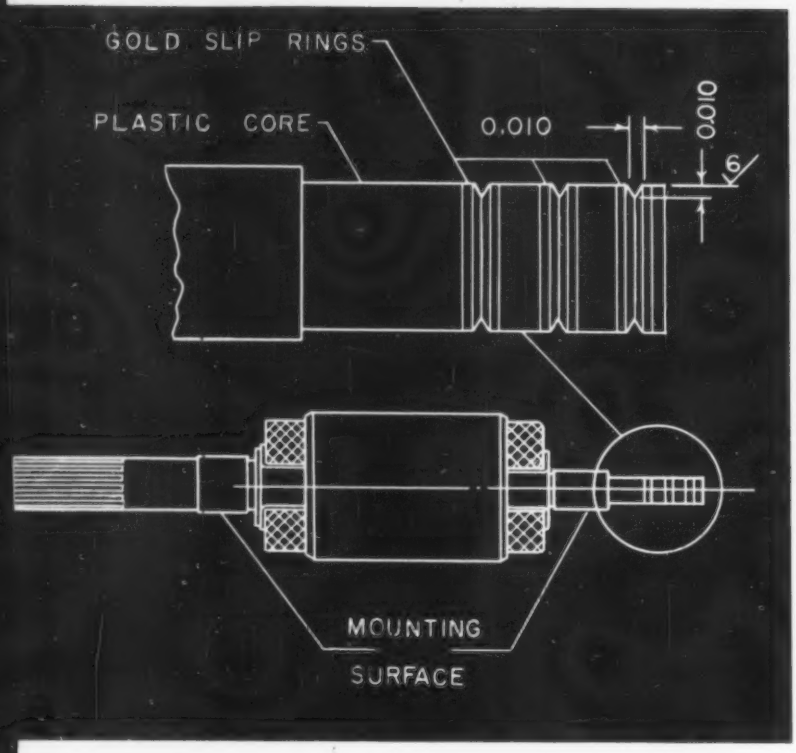


Fig. 1. Synchro rotor is supported on its journals during crush-form grinding of gold and plastic slip-ring assembly. Details of this assembly are seen in partial, enlarged view at top.

tween a 16- and 32-micro-inch surface finish. If the roughness is greater than 32 micro-inches, measurement to these tolerances is too difficult. On the other hand, if the finish is not rougher than 16 micro-inches, the surface is too smooth and the microscopic valleys in the material are not deep enough to accommodate the metal forced into them when the balls are pushed through. In ballizing, a set of three or four steel balls, carefully selected for size, are pushed through the hole in the proper order. The balls can be used over and over as the chance of using the same line of contact on a ball to size more than one work-piece is remote.

Special ball bearings for gyros and certain other applications are made at the company's precision ball-bearing pilot plant. The balls for these bearings are purchased but the inner and outer races are machined to tolerances of 0.000015 to 0.000020 inch on roundness and concentricity. Seven or eight different types are produced in various sizes but in limited numbers.

In a unique operation, the inner races of bearings are burnished to a 3 1/2-micro-inch finish using a monocrystalline ceramic wheel in a Hauser burnishing machine (Fig. 6). Since this process is actually a metal-cutting operation, the race is brought almost to the final, 1-micro-inch finish without distortion. The burnishing wheel is dressed with a diamond to the desired radius. To

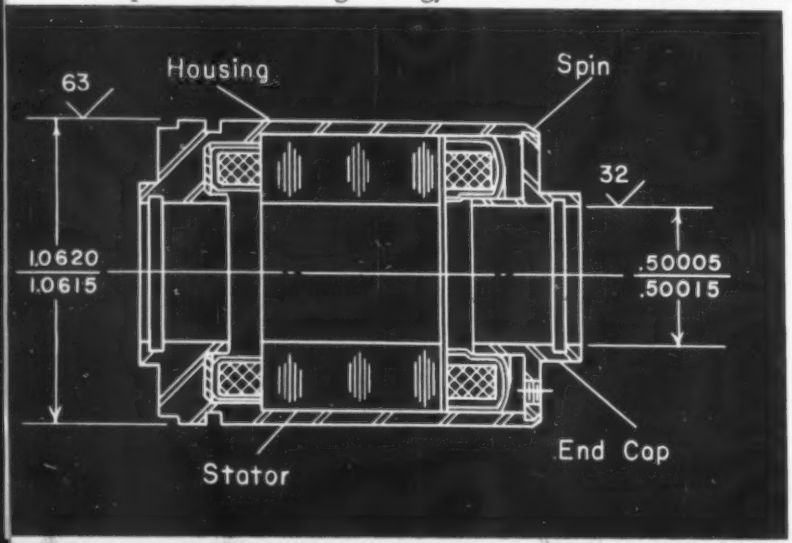


Fig. 2. Periphery of this synchro stator and housing assembly is ground to serve as a locating surface for machining until the bore is honed. End cap is retained by spinning edge of housing over chamfered edge of cap.

Fig. 3. The bores of synchro stator and housing assemblies are being rough- and finish-honed. Special holding fixture indexes the work-pieces from one operation to the other. Air gages (left) are employed to check the bores at the machine.

check the radius, the wheel is held against the mating edge of a metal template and viewed in an optical comparator at 100× magnification. Any imperfections are easily detected by light showing between the template and the wheel. After burnishing, the inner races are polished to a 1-micro-inch finish with either a diamond paste or a 3000-grit aluminum-oxide rope.

Fine pitch gears having total composite errors as low as 0.00025 inch are required in many navigation and control instruments for aircraft and missiles. A gear of 80 diametral pitch, 20-degree pressure angle, and 1.500-inch diameter is shown being checked for total composite error on an S & F gear tester in Fig. 7. In this equipment, work gears are run in mesh with a master gear and any errors present are amplified 800 to 1. Results are mechanically inked on graph paper tape by a Graphotest attachment for permanent record. From the tape, an analysis can also be made of the total composite error in terms of run-out and tooth-to-tooth composite error.

So delicate and sensitive are some of the mechanisms employed in inertial guidance and navigation systems that foreign particles too small to be seen by the naked eye can cause an instrument to become inoperative. To reduce this possibility to a minimum, the company has designed and constructed a special, enclosed, ultra-clean facility in which the assembly operations on instruments such as gyros are performed on a production basis. The ultra-clean section of the plant is self-contained and includes a stock room, locker room, washroom, lunch-smoking room, and rest room to minimize the need for assemblers to leave and re-enter the enclosed area.

A central air-conditioning system supplies the facility with air from which over 99.9 per cent of all particles 0.000012 inch in size and larger are removed by filtration. Clean air is important since experience has shown that airborne particles are largely responsible for the contamination of in-

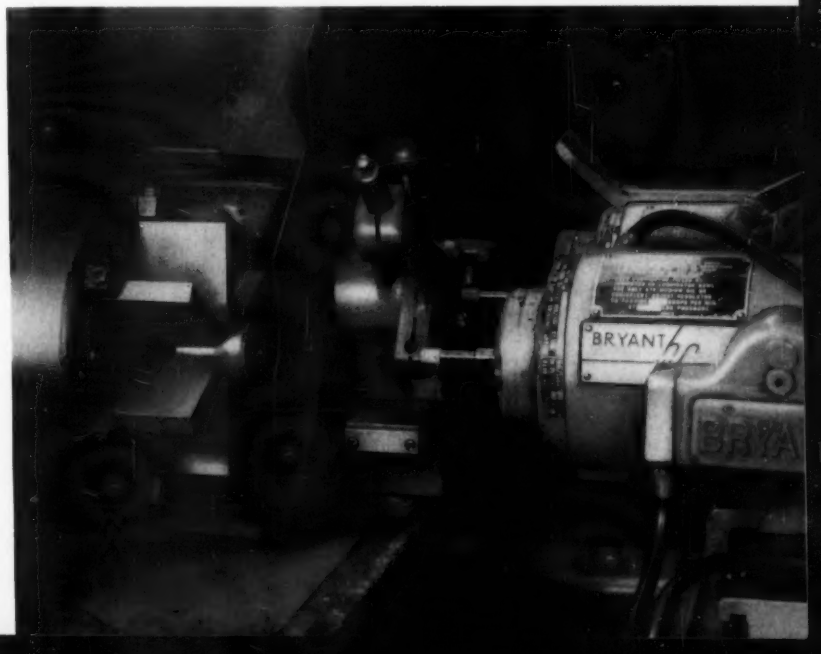


Fig. 4. Diaphragm chuck accurately locates this instrument assembly by means of the housing periphery for internal grinding of the bore. This type of chuck is employed for a number of other machining operations.

Fig. 5. Here, a mechanic is seen setting up for production of an instrument part in a Swiss type automatic screw machine. To meet concentricity requirements, as much machining as possible is done in a single chucking.

struments at assembly. In addition, the air supply is maintained at a constant temperature of 75 degrees F. and a relative humidity of 40 per cent.

The rate at which the dust-free air is changed in the various rooms is controlled according to the rate at which it becomes contaminated. For example, the air in the ultrasonic cleaning room is replaced every eighteen seconds while that in the final assembly room, which remains cleaner longer, is completely changed every forty-eight seconds. Whereas air is supplied at 3 pounds per square foot above normal atmosphere pressure in the final assembly room, the pressure maintained in the other rooms is less and varies according to their use. Rooms in which the greater degree of cleanliness is required always have the higher air pressure. This arrangement prevents relatively contaminated air from entering cleaner areas when personnel pass from one room to another. An intercommunication system helps eliminate much interroom travel.

To simplify cleaning, smooth vinyl materials cover the walls, floors, and ceilings, and the doors and window frames are made of stainless or chromium-plated steel. A black floor covering is used so that dust can be easily detected.

Employes enter the ultra-clean area through a decontamination anteroom where they clean their shoes with a vacuum brush, walk on a tacky gelatin mat, and pass through a high-velocity, multiple-directional air shower. Dislodged dirt is removed through an exhaust at floor level. After this, each assembler washes, puts on an orlon coverall, nylon boots, and a nylon cap, and passes

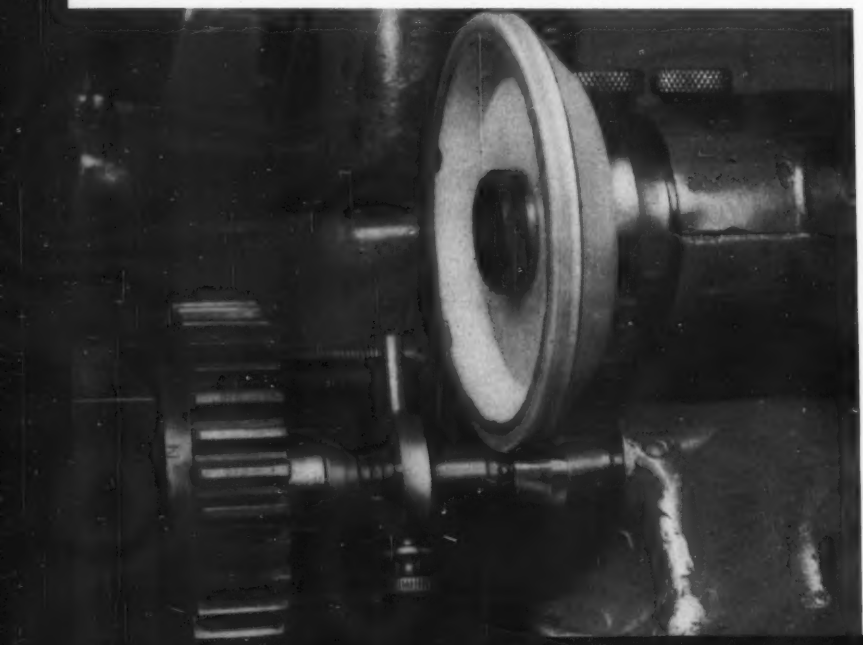


Fig. 6. An inner race for a special instrument bearing being burnished to a 3 1/2-microinch finish prior to final polishing. Since the wheel is dressed to the proper radius, the race is not distorted during the burnishing operation.

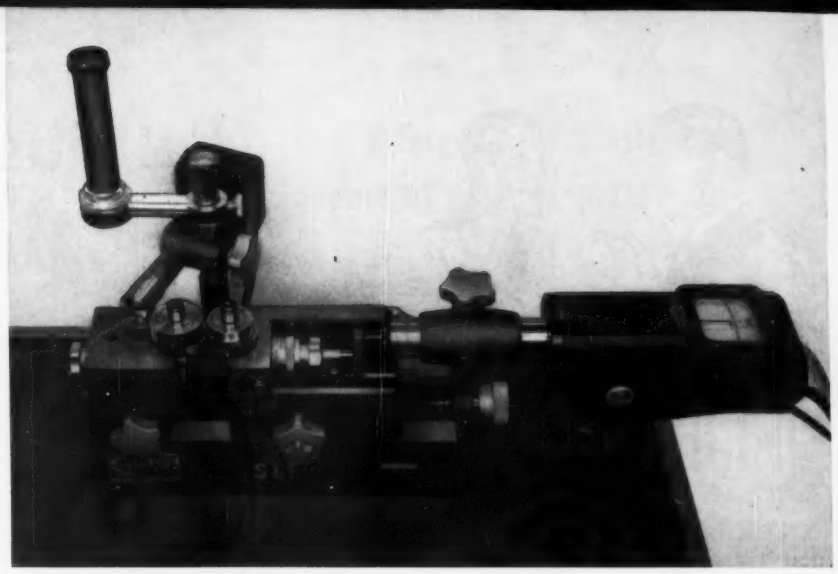


Fig. 7. This gear tester mechanically inks a permanent graphical record of test results on paper tape (extreme right). In operation, the work gears are run in mesh with a master gear of the same pitch. Errors are amplified in the ratio of 800 to 1.

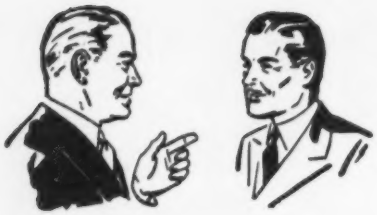
through a second decontamination procedure. He is then ready to enter the work areas.

Instrument components are delivered to the stock room within the ultra-clean facility through a special "pass-through" tunnel and stored on stainless-steel shelving. Prior to any assembly operations, the parts are placed in lint-free, non-shedding containers and passed through a similar tunnel to another room for ultrasonic cleaning in specially built equipment. In addition, sub- and final assemblies are cleaned in this area. In Fig. 8, a gyro sub-assembly is seen being placed in an ultrasonic cleaning machine for processing. The exhausts from this equipment are discharged to the outside atmosphere. Ultrasonic cleaning fluids are piped, at the rate of 4 gallons per minute, to an adjacent building; filtered of all particles larger than 1 micron (0.000039 inch); and returned to the machines.

After ultrasonic cleaning, sub-assemblies are loaded on stainless-steel trays under a hood pressurized with filtered air. A conveyor carries the trays from the ultrasonic cleaning area directly to a sixteen-station, pressurized booth in which final assembly of the instruments is performed. Slots and louvers allow a continuous discharge of filtered air at the rate of 70 feet per minute and cutouts are provided for the arms of each assembler. As added precautions, assemblers wear protective lint-free coverings on their fingers and their tool kits are inspected and ultrasonically cleaned at the end of each shift.

In the heading illustration, a technician is seen assembling a floated rate-integrating gyro at one of the special hooded stations. Test devices employed for checking the instruments during final assembly are mounted outside of the booths and at eye level. On completion of assembly, instruments are protected by a cover and sent to another room for sealing and final testing.

Fig. 8. Loading gyro assemblies into an ultrasonic cleaning machine. All parts and containers are thoroughly cleaned before and after assembly operations. The assemblers' tool kits are ultrasonically cleaned after each shift.



Talking With Sales Managers

BERNARD LESTER
Management Consulting Engineer

Be Alert to Change

NOTHING challenges the machinery builder more than alertness to market change. Nothing can advance a marketing department more than being prepared to meet these changes.

Let us illustrate why an early recognition of market change is far more important today than ever before. Alterations in customers' corporate control, geographic location, and types of products occur considerably faster now than formerly. Also, production processes embrace new techniques.

Customers demand quicker service. Think of what automation, in its various forms, has done to necessitate faster action by the supplier in furnishing technical data, specifications, and quotations. To avoid untold loss, maintenance service, irrespective of nature and source, is now timed in minutes.

Purchasing methods and associated personnel, too, are changing. One buyer recently remarked, "We like to buy from Jackson because he understands how we do business." Upon further probing he said, "The way we buy equipment has changed a lot even in the last year. Jackson moves just as fast as we do, and in the right direction, too."

Thus, customers change, but so does competition. Many a salesman is startled to find some unknown supplier bidding against him. He also may be surprised to find a competitor offering equipment that involves techniques and processes quite different from those used in his own plant.

Alertness to change does not come about without a high degree of concentration on the market and a simple method of reporting trends. These trends and noticeable changes rate an immediate response. With prompt report and interpretation, short- and long-term plans, as well as policies, products, and personnel, can be developed. Let us cite two situations in which alertness to change will be amply rewarded.

What is brewing in the smelting pot of international relations and politics to affect next year's defense spending? Many segments of our economy depend a great deal on the altering character and volume of government defense appropriations.

Second, what will the Great Lakes–St. Lawrence Seaway (to be fully completed by 1962) do to industry in and about our seaboard cities on the Great Lakes? Some of us may be surprised to learn that Cleveland is closer to Liverpool than is Baltimore. How will all this influence our Canadian neighbors, our foreign competition, and our own export business? Chain reactions from the opening of this giant waterway will affect most of us in a way that is, in the beginning, hard to grasp.

Though our alertness to market change may need to be stimulated, some control is necessary. We sometimes see marketing officials who are so alert—so hypersensitive to market change—that they frequently dart here and there, like someone slapping at mosquitoes. On the other hand, some of them apply depth analysis for detecting long-term trends to the point of diminishing returns, and the results of their work accumulate unused in their files. Fortunately, both types are far outnumbered by those who recognize that a study of the changing market is to be followed by decision promptly put into effect.

From the standpoint of the marketing organization, some observations may have value. First, market-research men cannot operate effectively if kept behind closed doors. To detect and accurately report on changes, they should be where the change takes place.

Second, successful salesmen, being highly perceptive, are a leading source of market information that spells out change. Encouraging salesmen to observe, and to report their observations, lifts their confidence in management. Finally, close correlation between the product manager and the market analyst can be highly rewarding in your search for increased profits through new and improved equipment. As is generally the case, teamwork will pay off.

How a forge plant controls the quality of rotating parts...

DIRECT-READING DYNAMIC BALANCING

TO OBTAIN greater efficiency from many types of rotating equipment, manufacturers have increased operating speeds and specified closer machining tolerances. Higher speeds result in greater horsepower output and production, while closer tolerances increase reliability and lengthen service life. Both of these design trends have led to a greater need for dynamic balance since vibration is not only a direct waste of energy but also a major cause of breakdowns.

Precise dynamic balancing is an important requirement of such products as diesel locomotive crankshafts, marine propeller shafting, and paper-mill rolls made at the National Forge & Ordnance Co., Irvine, Pa. Although these machine members vary greatly in length and diameter and operate at widely different rotational speeds, they are processed in two Trebel dynamic balancing machines of identical design.

The larger machine (Fig. 1) has a capacity of 33,000 pounds and is used for balancing large paper-mill rolls and marine propeller shafts up to 50 feet long. Diesel locomotive crankshafts, smaller paper-mill rolls, and large flexible couplings are balanced in the equipment seen in the heading illustration. This smaller machine, having a weight range of 130 to 13,000 pounds, can accept rotors up to 68 inches in diameter and 22 feet in length. Work-pieces are supported on individually adjustable yet self-aligning rollers accommodating a range of journal diameters. Clamp-on driving dogs provide the connection between the work-piece and a flexible drive on the faceplate of the machine for general balancing work.

Due to their flexibility, some types of crankshafts must be supported for balancing in the same manner as they would be in an engine block. For this reason, these crankshafts are supported on up to five self-aligning independent roller carriages which slide in ways on a specially designed table. The entire table can be inserted into the smaller balancing machine and adjusted up and down for different journal diameters. In this case, the drive is by means of a telescoping, universal-joint shaft which connects the crankshaft flange to the faceplate.

The design of a rotating machine part usually determines where weight can be applied or removed. For this purpose, the machine has two plane selectors which are placed vertically below

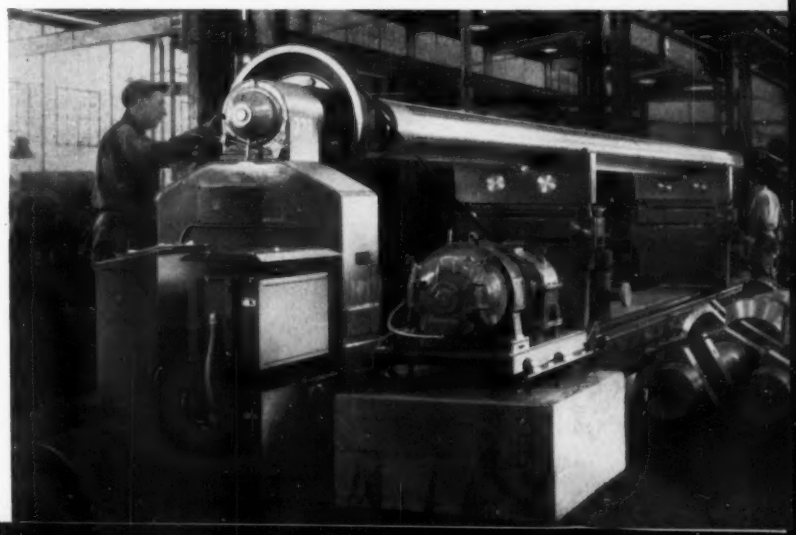


Fig. 1. Here, a 42-foot, 15,000-pound marine propeller shaft is being tested for dynamic balance. Operator can determine any required corrections directly from dial readings. The unbalance is read in ounce-inches and the position, in degrees.

the work-piece in the two planes in which the addition (or removal) of weight is practical.

Once the machine has been adjusted for the particular length, journal diameters, and correction planes of the part, the amount and location of unbalance can be read immediately on operation directly in ounce-inches. Electrical "pick-ups" mounted on the two main supports register the amount of unbalance as the shaft rotates. Simultaneously, the angular position of the unbalance is shown on a graduated dial in degrees. After readings are taken referring to the two preselected correction planes, the required corrections are made, bringing the entire member into dynamic balance.

Indication of unbalance is accomplished by means of a counter-vibration produced in the machine headstock and transmitted into the work supports from underneath. Amplitude and phase angle of the counter-vibration are adjusted by the operator until the unbalance vibration is counteracted and a smooth running condition obtained. The counter-vibration then equals and is exactly 180 degrees out of phase with the unbalance vibration. This provides a means of determining how much and where weight must be added (or removed). By introducing the counter-vibration through a horizontal bar into the supports via the plane selectors, the amount and angle readings refer directly to the correction planes and not to the supports.

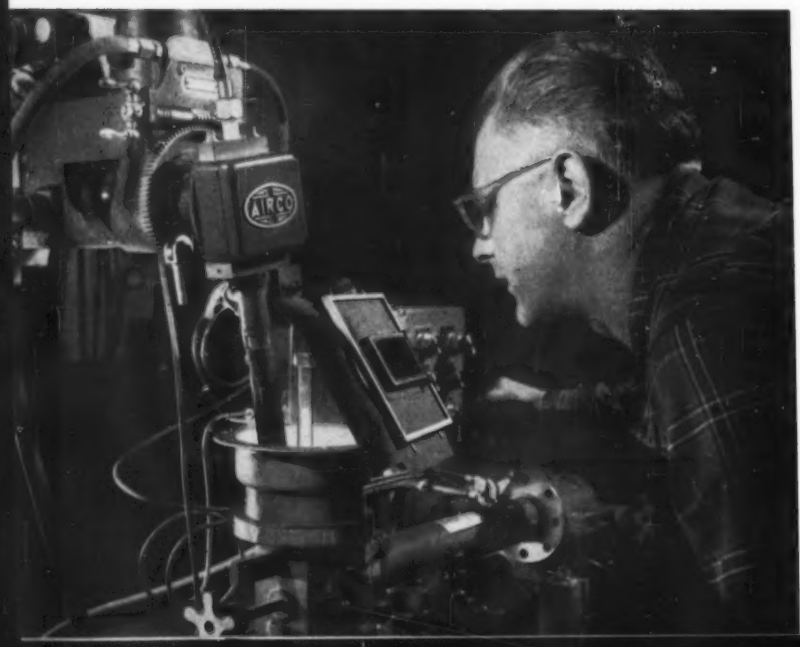
On crankshafts the unbalance is usually corrected by drilling into the counterweights. A table is used to determine the exact amount of weight that various diameter drills remove in steel or cast iron for any given depth of hole. On paper rolls, weights may be attached to the inside of the tubing, or holes drilled into the end pieces of the roll. Marine propeller shafts are generally balanced by making a correction during the finish-boring operation. After the required material has been removed (or added on the opposite side), a check run is usually necessary to make sure that any remaining unbalance is within permissible limits. With the machine at National Forge, it is possible to balance journals of work-pieces so that their amplitude of vibration is less than twenty-millionths of an inch.

Shielded Arc and Positioner Speed Welding

Welding time on the inner head of a diaphragm-housing assembly was slashed 90 per cent by substituting Aircomatic equipment for conventional stick-electrode practice at Taylor Instrument Companies, Rochester, N. Y. Taylor specializes in furnishing processing industries with instruments which indicate, record, and control the flow, temperature, pressure, and other characteristics of steam, gases, and liquids.

When manual stick-electrode arc welding was performed, distortion was encountered. In addition, a time-consuming shot-blasting operation was needed to remove slag. Now, using a gas-shielded metal-arc process, there is a complete absence of distortion, and the post-welding cleaning operation is unnecessary.

An Aircomatic head is mounted on a welding positioner which Taylor engineers designed and built. During the welding, the fixture rotates the work. Welding wire is fed to the head via a cable from a reel suspended overhead. Next to the table are a 300-ampere D.C., Bumblebee power unit and the shielding gas supply (argon plus 2 per cent oxygen).



The inner head of a diaphragm-housing assembly for a control valve actuator is welded as the fixture rotates.

AGMA Elects New Officers . . . .

(Left to right) John L. Buehler, president of the American Gear Manufacturers Association; J. F. Murray, vice-president, products division; Folke Richardz, vice-president, technical division; and Granger Davenport, recipient of the Association's "Edward P. Connell Award"

At the Forty-Third Annual Meeting of the American Gear Manufacturers Association held at the Homestead, Hot Springs, Va., June 1-3, 1959, John L. Buehler was elected president. Mr. Buehler is president of Indiana Gear Works, Inc., Indianapolis, Ind., a company he started in partnership with his father in 1933.

Folke Richardz, consulting specialist for gearing products at the Westinghouse Electric Corporation, Pittsburgh, Pa., was re-elected vice-president of the technical division of the Association. Other officers elected were: vice-president, products division—J. F. Murray, president, Winsmith, Inc., Springville, Erie County, N. Y.; and treasurer—Charles F. Bannan, vice-president, Western Gear Corporation, Lynwood, Calif.

Three members elected to the Board of Directors were: Robert O. Bass, president, Morse Chain Co., Ithaca, N. Y.; E. R. Fellows II, vice-president and general manager, Fellows Gear Shaper Co., Springfield, Vt.; and F. D. Weatherholt, manager, gearing division, Westinghouse Electric Corporation, Pittsburgh, Pa.

Granger Davenport, chief engineer, Gould & Eberhardt, Inc., Irvington, N. J., was the recipient of the American Gear Manufacturers Association's "Edward P. Connell Award" for 1959. This award is given not oftener than once annually to an individual who has made outstanding personal contributions to furthering the art of gearing. The citation on Mr. Davenport's award read: "In recognition of his many and valuable contributions to the work of AGMA as a member and chairman of many of its committees and of his long service to the gear industry in general."

E. D. Knabb, Bell Telephone Laboratories, Inc., presented a technical paper entitled "Design of Fine-Pitch Worm and Helical Gear Combinations." S. B. Daniels, Aircraft Industries Association, gave an address, "Looking Ahead"; and Andrew F. Oehmann, Lamb & Long, talked on "Some Prerogatives Under Current Tax Laws." An address by William H. Lawrence, Washington and White House correspondent for the New York Times, was entitled "What's New?"

E. F. Borisch, retiring president of the Association, announced that the AGMA Index for the month of April, 1959, is computed to be 255.6, which is a volume increase of 9.1 per cent in the gearing industry over the preceding month. Indices are based on average monthly shipments, with 1947-1949=100.0.

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Continuous Welding of Skins to Honeycomb Cores

The "Grimland Process" has been developed by M. M. S., Inc., Marietta, Ga., for the continuous welding of aircraft and missile skins to honeycomb core materials. Single or multiple contoured parts of variable thickness and similar or dissimilar metals can be welded in this way. Sensing devices are used to automatically determine where the weld pattern is to be applied, and to measure the results of the welds obtained. It is claimed that sections are up to six times as strong as those produced by brazing.

Trade Fair Reveals Growing Japanese Machine Tool Industry

ATHEL F. DENHAM, President
Denham & Co., Detroit, Mich.

DESPITE the fact that Japan's industries are expanding at a rapid rate and that most of its own machine tool builders have a six- to eight-month backlog and can sell everything they make, the immediate outlook for volume sales of American machine tools in that country is far from bright. Best prospects are for those builders in the United States offering special machines not available locally as well as for those who have been able to negotiate licensing agreements with Japanese builders.

Current policy in Japan disallows importing any machine types and sizes produced at home. Further, before a customer can order a machine not available locally, members of the Japanese machine tool industry must be given the opportunity to supply the equipment, even if a delivery date of two years is involved.

Political considerations enter into the sale of foreign-built machine tools, since Japan is rapidly trying to reverse its position from the role of machine importer to that of machine exporter. By the fall of 1960, or by 1961 at the latest, Japanese builders probably will be invading foreign markets in strong competition with the Germans and Russians, as well as with ourselves.

At the Tokyo International Trade Fair this May there were 263 machine tool exhibitors, accounting for many hundreds of individual items of equipment. Of the total, 142 of the exhibitors were Japanese. Since the Japanese builders are discouraged from competing with each other on machine types and sizes, the variety of machine tools displayed was even greater than the number of exhibitors would indicate.

Until recently, American builders apparently had a good market in Japan. Typical sales since World War II have been as follows: Fellows gear shapers, 70; Sunstrand Rigidmils, over 350; Heald grinders, over 150; and Gleason gear generators, over 400. Yet out of the fair's 263 machine tool exhibitors, only six companies (importers) displayed American-built machines. Combined, they represented but thirteen different nameplates and a total of only twenty-one machines! Ataka & Co., which had the biggest display, had three Gleasons, four Healds, one Fellows, and one Brown & Sharpe.

Toyo Menka Kaisha was next in line, with three Cincinnati milling machines and one drill sharpener, and one Micromatic honing machine. The other four importer-exhibitors were Mitsubishi, with one Ekstrom, Carlson milling machine, one Lees-Bradner universal hobber, and two Hardinge lathes; Kondoh, with one Elox electric-discharge machine; Toto Kiko-Sha, with one Magnetic Tool drill press; Marubeni-Iida, with one U. S. Tool multiple-slide machine. Some of these firms (especially Toyo Menka Kaisha and Mitsubishi) also had extensive exhibits of Japanese machine tools in other buildings.

Actually, the American-made machines ranked a weak fourth in exhibit strength. Ahead, aside from the Japanese, were West Germany with fifty machines and Switzerland with thirty-six. The latter consisted primarily of large high-precision toolroom equipment. Great Britain was represented with twelve machines, Italy five, and France, with three.

Exhibitors of American machines reported they sold practically all those displayed by the end of the second week. The Japanese still like to see "Made in U.S.A." (or even, "U. S. Designed") on the nameplates of machine tools. Many would prefer to buy them if permitted, despite the considerably higher price tags. Not that Japanese tools offered domestically are "cheap." In general, the price of a Japanese lathe or milling machine in Tokyo is about 25 per cent higher than its export price.

To date, the major users of American machines have been the Japanese automobile companies and anti-friction bearing makers. Another user is the Japanese machine tool industry itself, which leans heavily on its American counterpart for the rigidity and accuracy needed in constructing its own equipment. Shiboura, one of the biggest builders, for example, uses Giddings & Lewis planers for machining its large castings. Some Japanese manufacturers will buy American basic machines and then fit them with Japanese-built heads, in this way getting equipment of superior

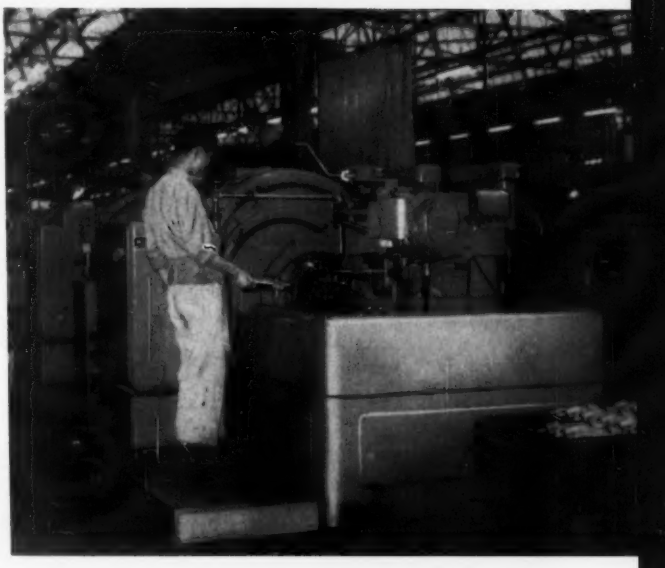
ruggedness while still conforming to government regulations.

Tape controls were very much in evidence at the fair. The bulk of the developmental work has been in the builders' plants, with the financial support of the government mechanical laboratory. Several machines were operated through digital-control panels somewhat like the General Electric and Westinghouse versions here. Hitachi, a prominent builder, has a transistorized control system of its own.

A few of the lathes on demonstration featured ceramic tooling. These tools are available in Japan as brazed tips, and mechanically clamped slugs and throw-away inserts. The non-indexable types have ground-in chip-breakers, while the indexable types have high-speed steel (rather than carbide) anvils as chip-curler insets. Round inserts are the most popular style among the throw-aways. Cutting demonstrations were usually at 280 to 300 sfpm (surface feet per minute) for roughing and 1000 sfpm for finishing, using fine feeds for a "ground" finish on steel up to 300 Rockwell A. The quality of Japanese ceramic tools has not yet proved too consistent, machine builders report.

The ship-building industry is making determined efforts to turn out tonnage in quantity, and has been a good machine tool customer. Of interest here is that none of the Japanese exhibitors showed any small gear-shaving machines. Those displayed were mainly of a size designed to handle ship-propulsion gearing.

Transfer machines, broaching machines, and other high-production equipment have thus far made little headway in Japan. Apparently, only two or three plants—in the automobile industry—use transfer machines, most being copies of American design, and even here they are limited to the machining of heavy castings. The broad availability of low-cost labor precludes any great popularity for high-production equipment.



(Top) Pratt & Whitney Keller machine at the Yokohama plant of the Nissan Motor Co., Ltd. (Center) A bank of Gleason No. 116 hypoid generators finishing pinion members for Datsun and Nissan-Austin automobiles at the same plant. (Bottom) One of a battery of Michigan No. 870 gear finishers producing motorcycle parts at the Saitama plant of the Honda Motor Co.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Norton Seven-Station Automatic Crankpin Grinding Machine

A seven-station crankpin grinder, believed to be the largest grinding machine ever built, has successfully completed trial tests at the Worcester, Mass., plant of the Norton Co. This Norton unitized transfer type machine was designed to finish-grind the pins on up to sixty automotive type crankshafts per hour under completely automatic operating conditions. It is 19 feet wide, 90 feet long, and weighs about 135 tons.

The machine, Figs. 1 and 2, consists of seven grinding stations connected by a transfer system. All grinding, loading, unloading, size control, gaging, and wheel truing are done automatically. An operator is required only for making adjustments and to take corrective steps if the lights on the control panel indicate trouble.

Crankshafts are brought to the grinder by conveyor. Manual lifting is entirely eliminated. An overhead transfer carriage at right angles to the conveyor brings the crankshafts from the conveyor to the grinding position. The carriage has two sets of hooks. One set removes the ground crankshaft and the second lowers an unground crankshaft into the work-holding blocks as soon as the first one is removed. Total time that the wheel is not grinding or in actual contact with the work during the one-minute operating cycle is seventeen seconds.

While grinding is in progress, the overhead carriage returns the ground work to a position over the conveyor, picks up another unground crankshaft, deposits the ground one on the conveyor, and transfers the unground crankshaft to a waiting position over the grinding station, ready to be lowered at the next cycle. During the seventeen seconds that the wheel is not in contact with the work, the truing process takes place. This may be done at each cycle or after a predetermined number of cycles. Automatic truing devices true the face of the wheel and form the proper fillet radii on the corners of the wheel.

Because the pin on the crankshaft is not on the crank's center line, counterweighed work-holder blocks (see Fig. 3) are provided to place the axis of the pin to be ground exactly on the axis of the work rotation as determined by the headstock and footstock. Once the crank is angularly located, an axial locator comes into play which aligns the crank axially so that the wheel grinds an equal amount on each cheek. After alignment, the locator retracts, the crank is clamped, and the grinding cycle begins. At the end of the grinding cycle, the headstock drive is so controlled that the work-holding blocks are brought to a correct stopped position to discharge and receive the crankshafts.

The machine is designed to use 42-inch grinding wheels. The grinding cycle consists of a rapid infeed, fast rate for shoulder grinding, slower feed for roughing followed by a four-second dwell, and a very slow infeed for final sizing and finishing of the pin. The infeed is controlled by means of hydraulic valves.

Correct size is controlled by in-process gaging. When the final size is reached, air gages actuate the controls which retract the wheelslide, thus ending the grinding cycle. Wheel wear and diamond wear compensation are included to insure correct sizing.

Post process gaging is done on the ground crankpin when it returns to the conveyor. Three readings on each pin are taken simul-

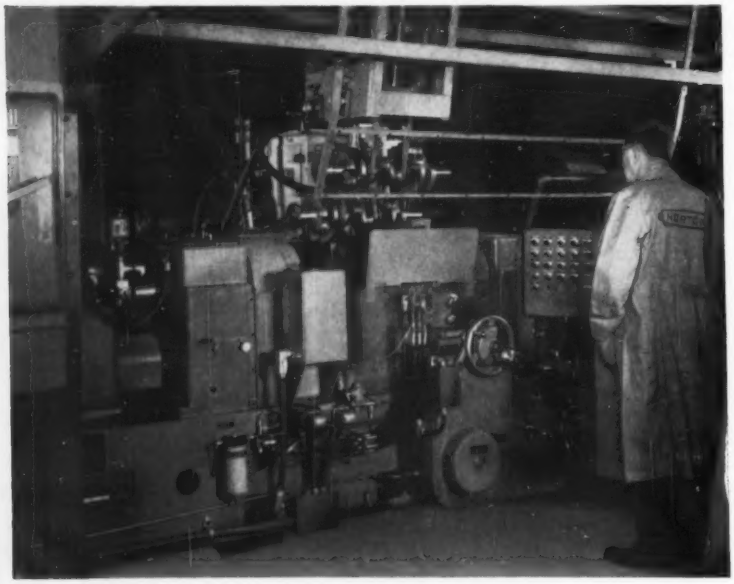


Fig. 1. Master control station for Norton No. 2 unitized transfer type automatic crankpin grinder

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

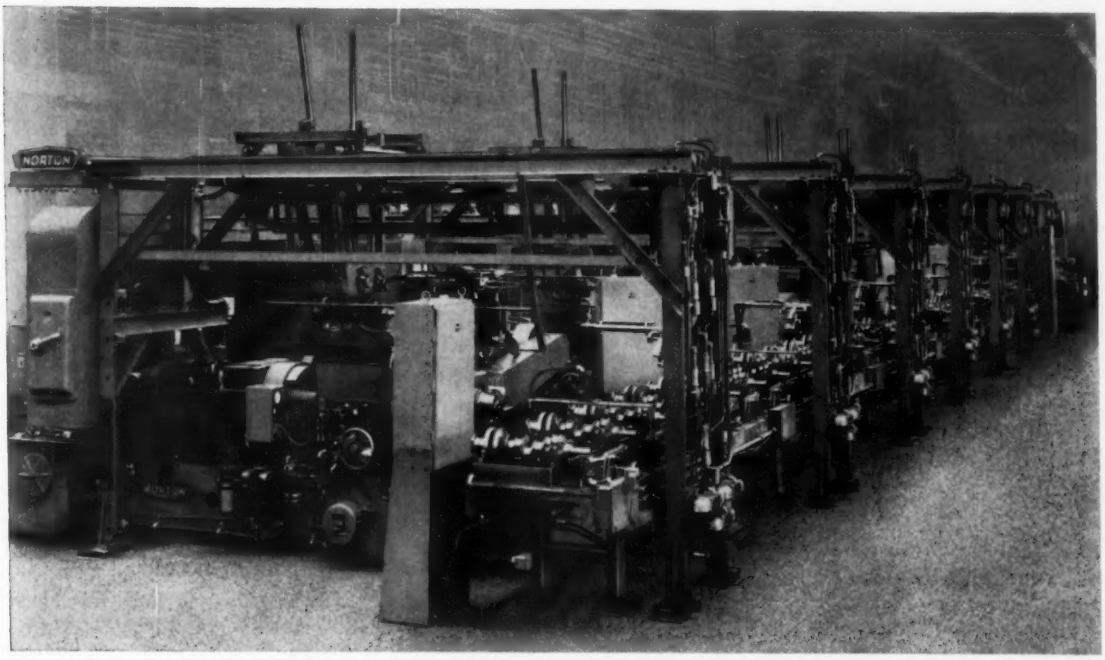


Fig. 2. General view of Norton automatic crankpin grinder shown in Fig. 1

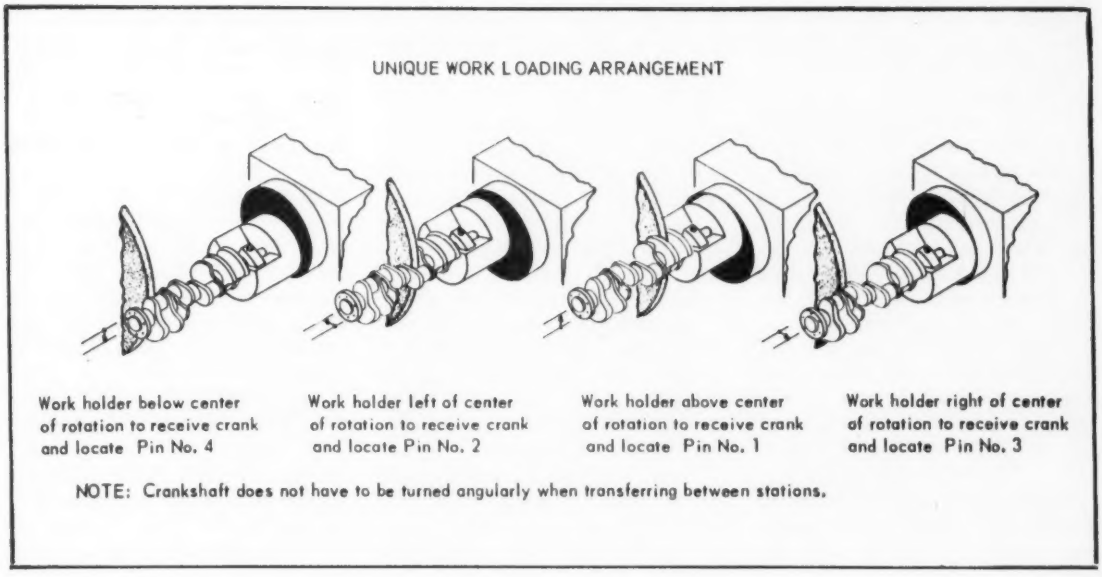

UNIQUE WORK LOADING ARRANGEMENT
Work holder below center of rotation to receive crank and locate Pin No. 4
Work holder left of center of rotation to receive crank and locate Pin No. 2
Work holder above center of rotation to receive crank and locate Pin No. 1
Work holder right of center of rotation to receive crank and locate Pin No. 3
NOTE: Crankshaft does not have to be turned angularly when transferring between stations.

Fig. 3. Work-loading arrangement used on machine shown in Fig. 2

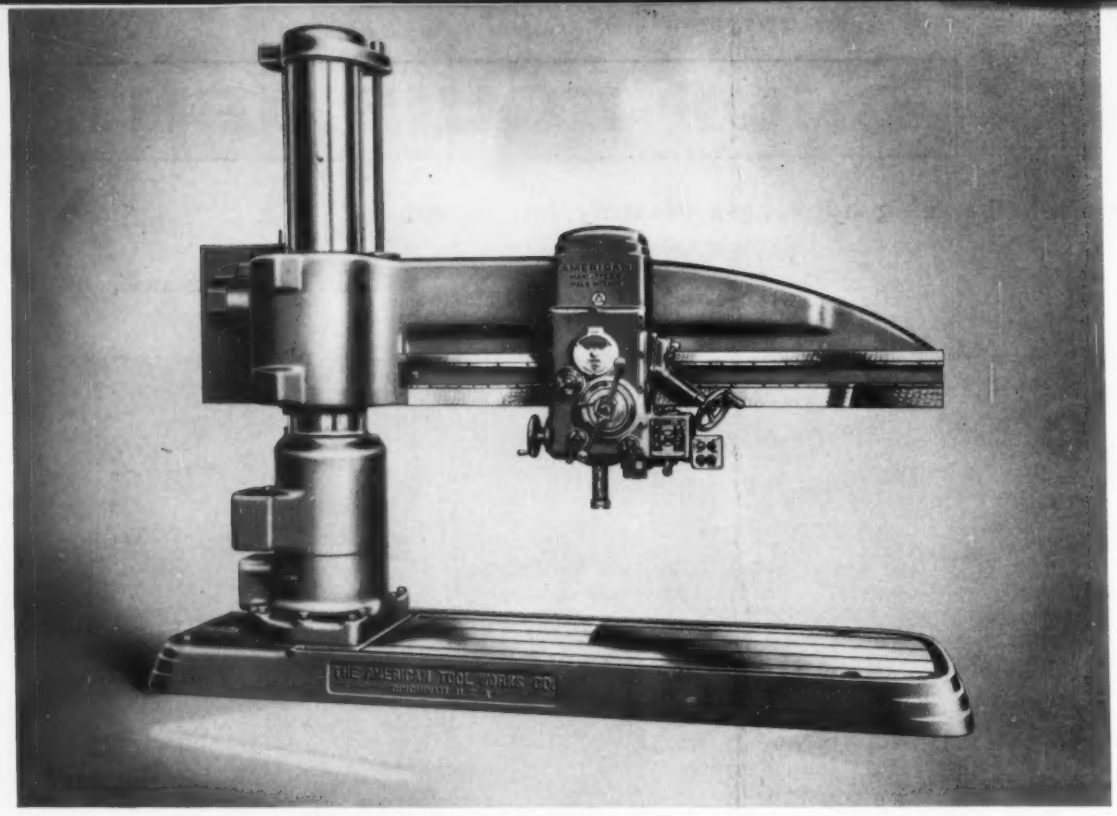


Fig. 1. "Maxi-Speed" Hole Wizard radial drill built by American Tool Works

taneously to check against taper as well as exceeded tolerances. If the part should exceed the required tolerance the grinding station responsible for the error is automatically stopped and the operator warned by means of signal lights. The rest of the machine can continue to operate by bypassing the one station causing the trouble. Gaging results can be seen visually on dial gages.

The seventh station is actually an extra station. It is a standard Norton semi-automatic crankpin grinder which can be adapted to single-pin grinding and is equipped with a transfer mechanism. It can be used as a substitute for any of the other stations which may be shut down for wheel changing, adjustment, or maintenance. A set of simple controls at the pick-up station on the conveyor is set by the operator to enable the seventh station to substitute for any other station. If additional capacity is needed, the seventh station can be operated as a conventional crankpin grinding machine with its own operator.

Circle Item 565 on postcard, page 199

American Hole Wizard Radial Drills

Two radial drills, the Maxi-Speed Hole Wizard, Fig. 1, and the American Hole Wizard, Fig. 3, have been announced by the American Tool Works, Cincinnati, Ohio. The Maxi-Speed Hole Wizard has been designed for those who need a radial drill using twist drills, boring tools, and taps in the medium size range. This machine is available in column sizes of 13, 15, and 17 inches, with arm lengths ranging from 5 to 8 feet. It is capable of a wide variety of economical drilling, tapping, and boring operations. The arm reach of the machine has been extended from 1 to 2 feet beyond the usual length for column radial drills of this size.

The drilling capacity of this machine in the solid is 2 1/2 inches in mild steel at a cutting speed of 85 feet per minute and a feed of 0.014 inch per revolution. The drilling capacity in cast iron is 3 inches. A fine feed boring attachment gives additional feeds as low as 0.001 inch per revolution. This radial drill can finish-bore a 3-inch-diameter hole in cast iron to a depth of 3 inches with an accuracy of 0.0003 inch in both roundness and taper.

Either twelve or twenty-four spindle speeds are available with the Maxi-Speed, depending upon the choice of a constant speed or two-speed motor. The motor, which is head-mounted, may be 5 or 7 1/2 hp. For critical facing operations, the two-speed driving motor provides a minimum spindle speed of 22.5 rpm while still providing a top speed of 2250 rpm for small-hole drilling. A close-up of the drilling head is shown in Fig. 2. The head-mounted driving motor is directly in back of the head shown in this close-up view. The housings for the head and driving motor are joined below the rail, making a rigid, well-balanced assembly.

The Maxi-Speed radial drill is well suited because of its rigidity, easy operation, and precision boring-mill type spindle for use in combination with precision positioning tables. Such a setup can be used successfully for accurate hole-spacing work, which usually requires jig plates, or for perform-

ing operations usually handled exclusively on jig borers or boring mills.

In Fig. 3 is shown the 19-inch American Hole Wizard radial drill which is available with 6-, 7-, and 8-foot arm lengths, and with a full complement of accessories. Power, rigidity, stability, and convenience of operation were major factors considered in designing this machine. As an indication of its tremendous power, it will transmit the full overload capacity of a 30-hp motor, while the column and arm designs are such as to permit the utilization of this power with the very minimum of deflection.

In addition to these outstanding characteristics, provision is made for performing highly accurate boring, counterboring, and spot-facing operations. To provide for these functions, boring-mill type spindles which are precision Timken bearing-mounted with convenient adjustment from the outside of the head are used. The super-accuracy of the nitralloy nitrided-steel spindles makes this machine especially adapted for the use of ultra-precision positioning (spacer) tables for highly accurate spacing and jig-borer types of work.

A 40 per cent speed-up of the spindle on reverse is provided in order to minimize the unproductive time of backing the tap out of a hole.

Circle Item 566 on postcard, page 199

Specialty-Grade Kennametal Inserts

Kennametal K11, a carbide with a hardness of 93 Rockwell A, is now a production grade of Kendex button inserts, made available by Kennametal, Inc., Latrobe, Pa. This insert is the same carbide which has been used successfully for finishing and light roughing of cast iron, alloyed cast iron, brass, bronze, and light alloys. It is now being used under certain conditions for light cuts on steel, as well as for machining unfired ceramic materials, resin materials, and plastics. It has been found particularly suitable for such precision operations as boring brake drums, machining camshafts, and finishing pistons and sleeves.

K11 is also recommended for die

Fig. 2. Close-up of head of machine shown in Fig. 1

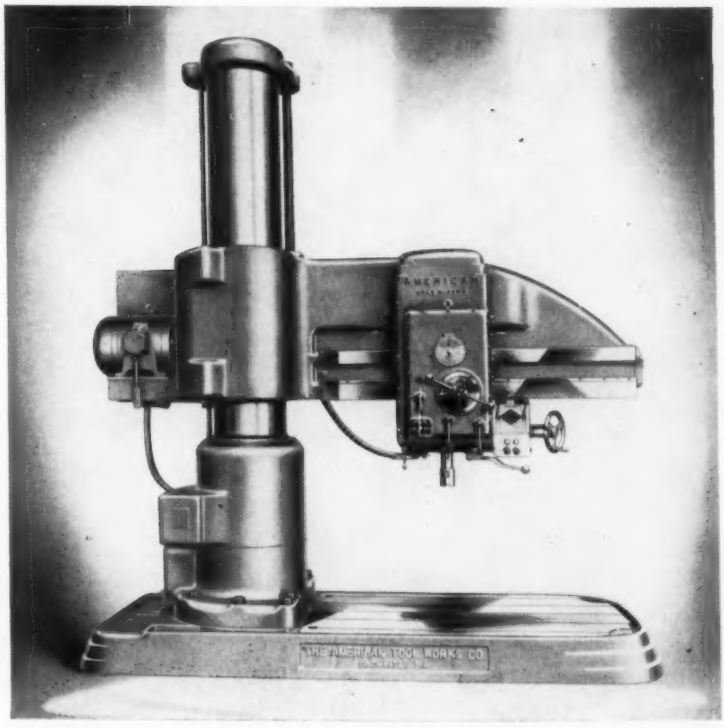


Fig. 3. American Hole Wizard radial drill with 19-inch column

inserts for compacting ceramics, abrasive wheels, and other applications where abrasion is severe. The performance of this carbide is illustrated in the turning of SAE 1213 steel rotors. At 298 surface feet per minute it increased the number of pieces machined per insert from 750 to 1000 up to 7500 to 9000. In machining cast iron it averaged 11.7 parts with an 0.008-inch wear land, which is a 3-to-1 improvement over the closest competitive carbide—9.7 pieces with a 0.016-inch wear land.

In test machining of Fiberglas missile parts K11 gave 15 per cent longer tool life than the best of three competitive carbides. It has since been used continuously on this job for more than a year.

The Kennametal K11 metal-cutting material is now stocked in fifteen precision-ground Kendex throw-away inserts, including triangular, square, and round shapes. Eleven of these inserts are of the negative rake type while four have positive rake.

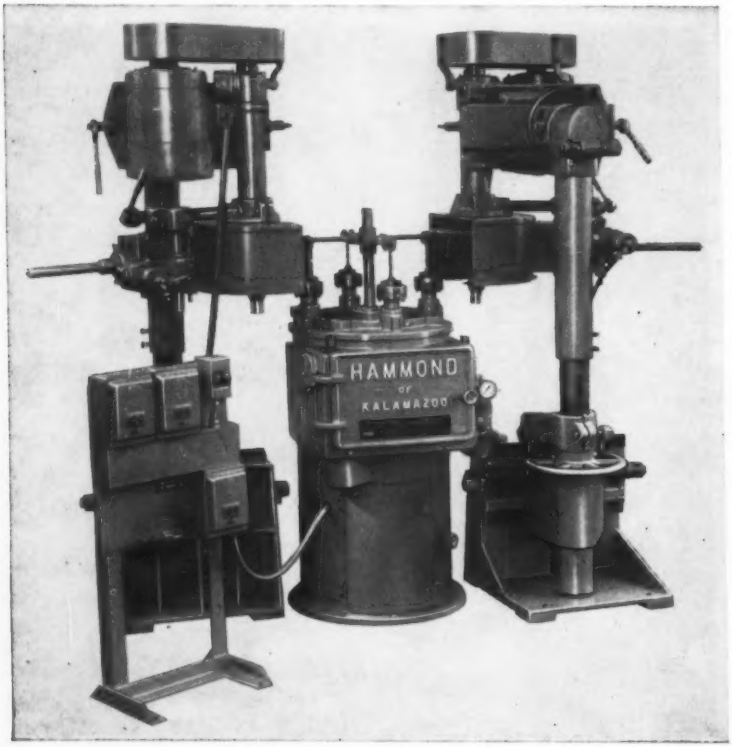
Circle Item 567 on postcard, page 199

Rotary Indexing Turret for Use with Polishing, Buffing, or Deburring Heads

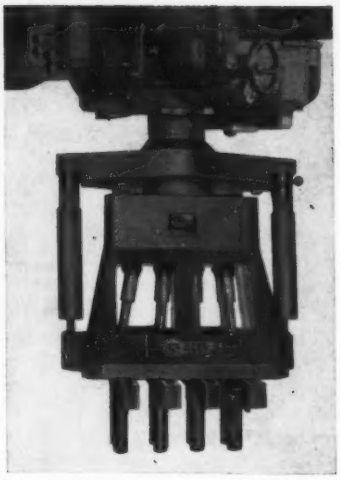
A Model J21-4 rotary indexing turret designed to produce the highest quality finishes at the lowest possible unit cost has been brought out by Hammond Machinery Builders, Inc., Kalamazoo, Mich. This machine may be used with one, two, or three polishing, buffing, or deburring heads as required to produce a desired finish. It incorporates all the features of the standard Hammond rotary automatics, has an operating range of 250 to 600 indexes per hour, and has been so designed that it requires only four work-holding fixtures.

A positive table lock is available for use on this turret for polishing operations or whenever all table movement must be eliminated during the working cycle of the machine.

Circle Item 568 on postcard, page 199



Hammond indexing rotary automatic with two brushing heads



Drill head mounted on radial drill by attachment made by the United States Drill Head Co.

Mounting Adapter for Adjustable Drill Heads

Multiple-hole drilling operations on cumbersome parts are said to be speeded up by an attachment for adapting multiple-spindle drilling and tapping heads to radial drilling machines. Made by the United States Drill Head Co., Cincinnati, Ohio, it consists of an air counterbalance and a 360-degree ball-bearing swivel attachment. With this attachment, the numerous sizes of universal-joint, adjustable and fixed-center multiple-spindle drill heads also built by this manufacturer can be added to any radial drill. The resulting flexibility provided by the combination of the radial drill, the swivel, and the universal-joint head is said to reduce production costs in drilling structural steel, tube sheets, flue sheets, condenser sheets, and other large-size parts. The attachment also insures maximum safety for the operator and the machine.

The air counterbalance is available in various strokes and handles the entire weight of the head and the tools. Two cylinders are employed to maintain a balanced condition of the head on the machine. There is no build-up of pressures to affect the feed mechanism of the radial drill. On the return stroke, the air is controlled to prevent too fast a return speed which could endanger the operator.

Circle Item 569 on postcard, page 199

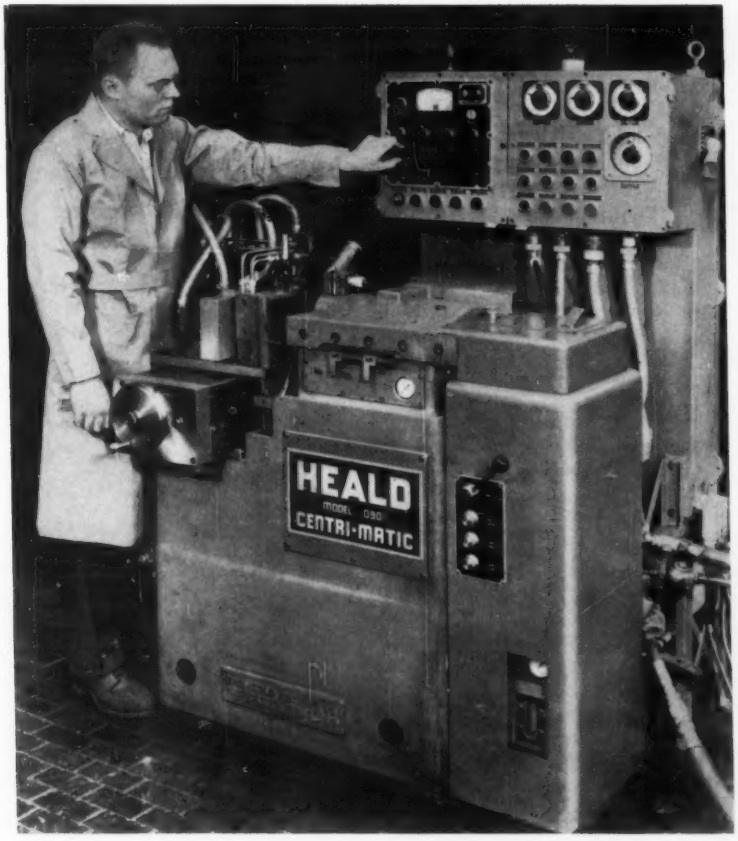
Heald Centerless Internal Grinding Machine

A Model 90 Centri-Matic centerless internal grinding machine especially developed for grinding miniature bearing races has been introduced by the Heald Machine Co., Worcester, Mass. With this equipment, inner races of bearings as small as 0.040 inch can be ground to a tolerance of 0.00015 inch and a 5-micro-inch finish in a fully automated fiifteen-second cycle. Work with a minimum outside diameter of only 0.050 inch can be handled. For development of this machine, said to be the first ever specifically designed for grinding miniature bearings, the company received a certificate of excellence in the 1958 Miniaturization Award class for unique systems-engineered design. This was the only machine tool to receive such an award.

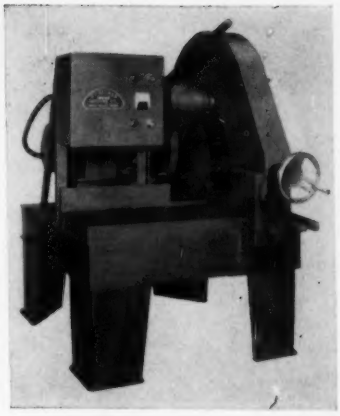
Design features include shoe type centerless work-holding; rotation of the part from both front and rear through a unique design of the work-head; and a series of wheel-heads capable of operating continuously at speeds well in excess of any other equipment now available. A hydrostatic, anti-friction feeding cross-slide is arranged for ultra-sensitive electronic control. Electronic controls are also provided for sensing and monitoring all other machine functions.

In operation, the part to be ground is rotated with its outside diameter held in contact with hard shoes against a rotating plate, which assures squareness of the ground bore to the face, while a high-speed grinding wheel reciprocates back and forth and feeds into the work to remove exactly the right amount of metal. Also incorporated in this grinder are completely automatic loading, part-sizing and ejection, and simplified tooling for easy change-overs.

Circle Item 570 on postcard, page 199



Centerless internal grinding machine for handling miniature bearing-race work



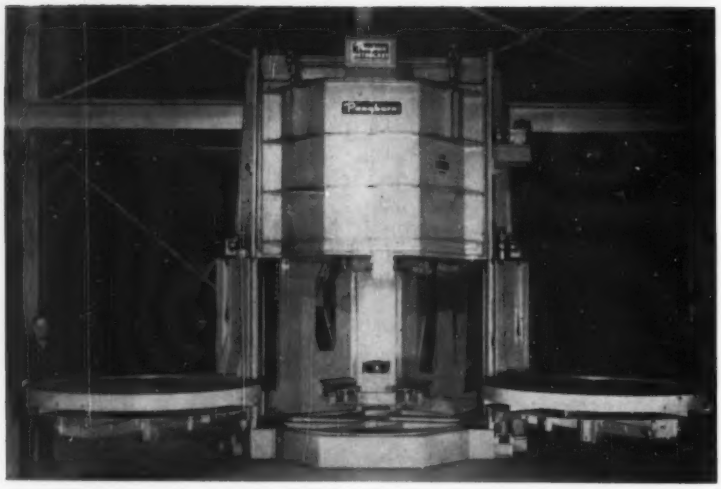
Ty-Sa-Man chop type metal saw

Chop Type Metal Saw

An all-purpose chop or swing type, high-speed metal saw has been announced by the Ty-Sa-Man Machine Co., Knoxville, Tenn. This saw has a 30-hp motor and is designed for friction or abrasive cutting. It can also be used with a grinding wheel and has a wide application in the metalworking field for both production and maintenance work. Clean, high-speed cuts can be taken on heavy structural members, bar stock, test sections, forging blanks, extrusion blanks, high-temperature alloys, die blanks, heavy cable, pipe, and many other materials. Equipment includes a powerful main motor (30-hp), sealed-bearing spindle, timing-belt drive, and a new dynamic suspension system that permits light, fingertip feeding without springs, counterweights, or adjustments.

The machine also has provision for straight or oscillating feed. When the oscillating control button is pressed, the blade moves forward and backward, in and out of the cut, in line with the cutting plane. This reduces the arc of contact of the blade, increases blade life, speeds up the cutting, and gives cleaner, generally burr-free abrasive sawing—either wet or dry. Oscillating speed is variable. The screw-operated double vise is quickly adjustable to handle up to 8- by 8-inch sections or solids. An air-operated vise and conveyor type roller table are available as optional extras.

Circle Item 571 on postcard, page 199



Twin-table Rotoblast room introduced by the Pangborn Corporation

Pangborn Twin-Table Cleaning Room

An 8-foot, high-capacity, twin-table Rotoblast room for cleaning individual castings weighing up to 5 tons has been introduced by the Pangborn Corporation, Hagerstown, Md. This equipment is designed for use in metal-working plants and all types of jobbing foundries. The twin-table system is shown in the illustration with both tables swung out and the door or shell raised to show the Rotoblast room. When in operation, one work-table of the machine is outside where castings or weldments can be reloaded, turned, or unloaded while the other table load is revolving inside the blast cabinet. This cuts lost time to a minimum. An air-operated clamp locks the table inside the cabinet and kicks the table out when released. The operator has only to walk with the table to keep it moving until latched in the "out" position.

The twin-table room features two Rotoblast wheels with 30-hp motors capable of throwing 100,000 pounds of abrasive per hour. One of the two wheels is mounted on the top deck of the room, blasting at an angle of 90 degrees to the table top. The second is positioned to provide thorough cleaning of top and sides of the work. Work-pieces up to 8 feet in diameter and 3 feet 6 inches high can be loaded on the table outside of the cabinet and positioned by any kind of handling equipment. After loading, the work-table is swung into the cabinet where the work is rotated under the blast streams.

Spent abrasive is removed by a scraper at the bottom of the blast cabinet into a trough where a 10-inch-diameter screw conveyor moves it to a rotating scalping drum for removal of coarse materials, tramp metal, wires, etc. Abrasive is then discharged into an elevator boot and elevated to the abrasive separator for cleaning and recycling. The power-operated vertical-lift door is lined with 1/4-inch rubber and protected by P-41 Pangborn Wear-Resist alloy in critical areas. Over-all dimensions of the machine are 24 feet 3 inches wide by 18 feet 6 inches deep by 18 feet 6 inches high.

Circle Item 572 on postcard, page 199

Twenty-Four-Station Transfer Line for Processing Bearing Caps for Truck Engines

Baker Brothers, Inc., Toledo, Ohio, have recently built a completely automatic transfer line that consecutively drills, bores, grinds, and faces bearing caps for twelve-cylinder truck engines. As a final

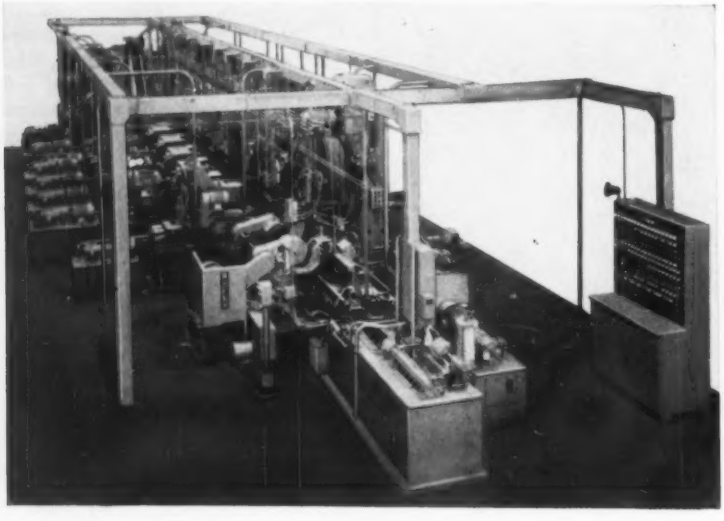


Fig. 1. (Left) Baker transfer machine for processing bearing caps

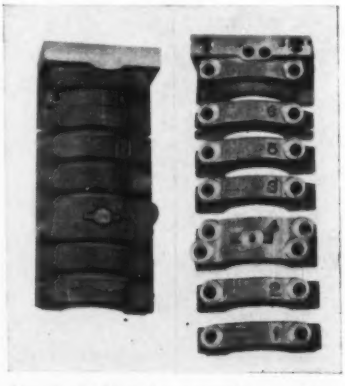
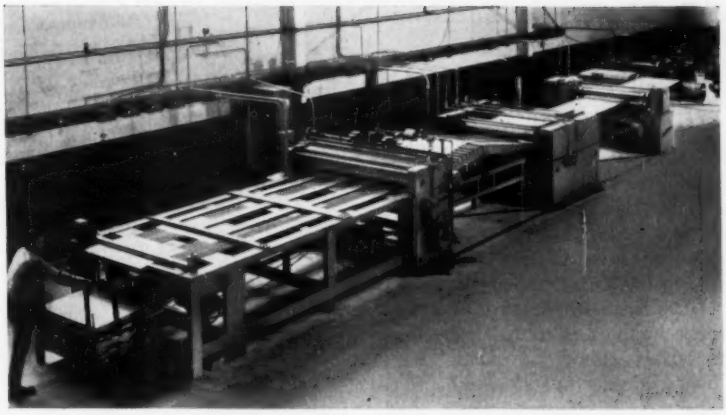


Fig. 2. (Right) Cluster casting before and after being machined and cut apart on machine shown in Fig. 1

step this equipment (Fig. 1) saws apart the individual elements of the cluster castings for delivery into their respective bins. The production rate is seventy parts per hour at 100 per cent efficiency. Shown in Fig. 2 are the cluster casting and the individual elements after they are cut apart.

For checking the maintenance points, a central-control console enables an operator to contact any of the twenty-four stations by means of telephone circuits. The control panel also keeps all stations coordinated by comparing the operation with a master pattern. This special machine also handles a similar part for six-cylinder engines. It is so designed that it can be easily and economically adapted to other jobs.

Circle Item 573 on postcard, page 199



Dahlstrom decoiling and shearing equipment

Dahlstrom Decoiling and Shearing Equipment

The combination of electronic surface measuring and positive mechanical sizing is a feature of a line of decoiling and shearing equipment brought out by the Dahlstrom Machine Works, Inc., Chicago, Ill. This equipment is designed to provide flexibility in the processing of coil stock into sheets. It is especially adapted for handling light-gage coiled stock at production speeds and heavier-gage material at a speed proportionate to the gage. Provision is made for instantaneous length change-over. Tolerance is always based on a plus or minus factor.

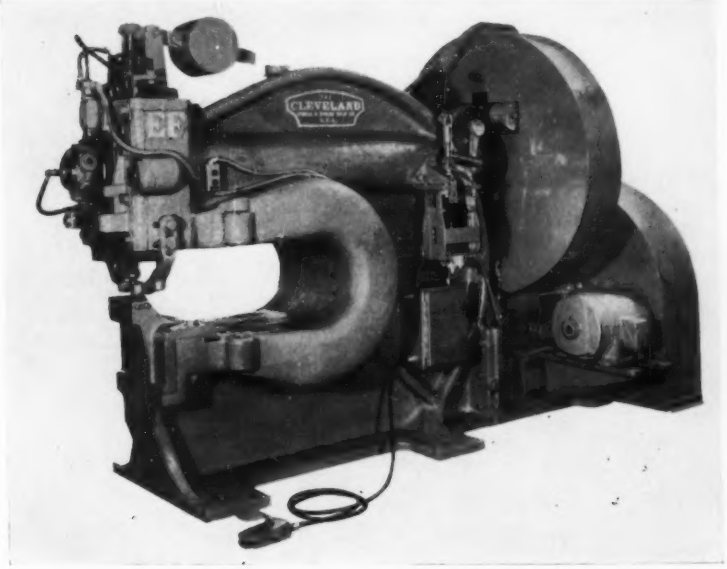
Circle Item 574 on postcard, page 199

Open-Gap Machine for Fabricating Operations on Heavy Steel Plate and Structural Members

A solenoid-operated clutch and completely guarded gears and flywheel are features of a Type EF vertical open-gap machine brought out by the Cleveland Punch & Shear Works Co., Cleveland, Ohio. This unit, delivered to a leading steel supplier, will be used in fabricating heavy steel plate and structural I-beams and girders. In addition to its punching attachment, the machine can also be equipped for flue-hole punching, notching, and coping, as well as for shearing angles, plates, and bars. Its solenoid-operated clutch automatically stops the machine at the end of each operating cycle, eliminating the danger and scrap resulting from a machine that depends upon the operator to keep a cycle from repeating. If desired, however, this equipment can be built for conventional, automatic type operation in cases where the solenoid-produced, semi-automatic action is not wanted.

An automatic lubrication system provides for smooth operation and longer wear. The machine has a punching pressure of 97 1/2 tons with sufficient capacity to punch a 1 1/4-inch hole through steel 1 inch thick, enabling the operator to fabricate all standard and Bethlehem sections from 7-inch I-beams to 30-inch girders, including 14-inch columns punched in the flange and web. It is also capable of shearing 7/8-inch plate and will square shear angles 4 by 4 inches by 1/2 inch. This type of machine can be furnished with throat depths from 12 to 60 inches.

Circle Item 575 on postcard, page 199



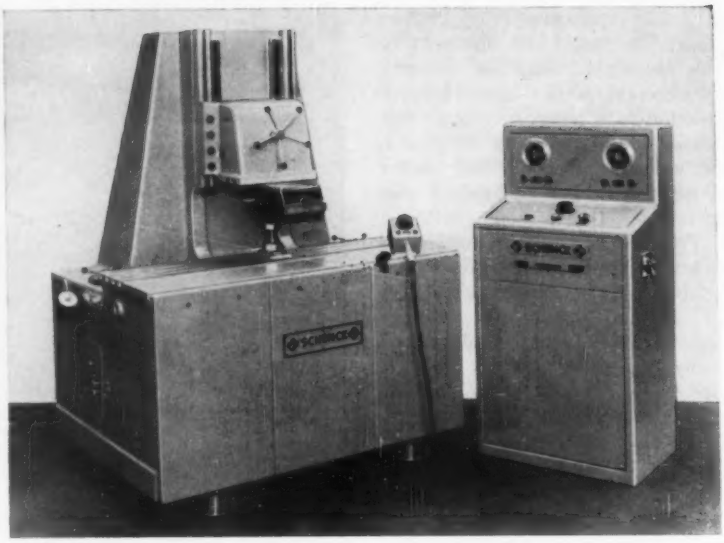
Vertical open-gap punching and shearing machine built by Cleveland Punch & Shear Works Co.

Fatigue-Testing Machine

A universal pulsator "PUV" vertical fatigue-testing machine has recently been added to the Schenck line sold in this country by the Cosa Corporation, New York City. This testing machine is available in four sizes, covering a load range of from 6 to 20 tons, and a frequency range (load cycles) from 600 to 10,000 cycles per minute.

The large stroke of this equipment enables it to test very soft materials (rubber or plastic) with low frequency, and rigid parts (gear wheels, connecting-rods, steel test bars, etc.) with high frequency. It also enables the machine to apply torsion and bending tests.

The basic vibrating-head movement develops a push-pull action. A series of standard accessories, however, permits easy conversion for bending, torsion, or other tests. Various gripping devices, heating and freezing chambers, and program-control attachments are also available.

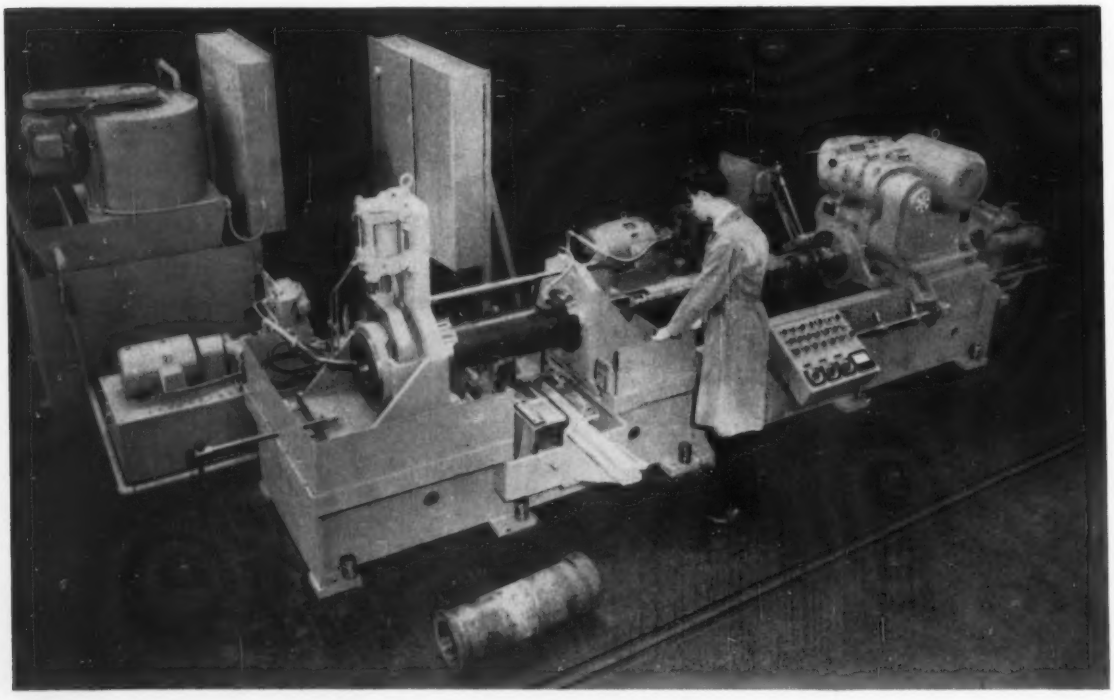


Universal fatigue-testing machine introduced by the Cosa Corporation

Circle Item 576 on postcard, page 199

Heavy-Duty Horizontal Honing Machines

The Micromatic Hone Corporation, Detroit, Mich., has designed a line of heavy-duty horizontal "Microhoning" machines intended primarily for applications requiring heavy or rapid stock removal from large diameters and longer than average bores. For instance, on one application, a Model B-612 machine of this series is Microhoning bores in oil-well liners that are hardened to 64 Rockwell C. These bores range from 4.50 to 7.75 inches in diameter and up to 30 inches long. A special feed unit employed in this case is capable



Micromatic heavy-duty horizontal honing machine

of exerting an exceptionally large thrust force which makes it possible to remove 1.3 cubic inches of stock per minute.

This machine has two separate feed clutches—one for rapid approach and tool collapse, the other for finer feed. The feed unit also includes a mechanism that automatically compensates for abrasive wear. The machine has a 4-foot hydraulic head stroke and eight-speed transmission. It is also equipped with a variable-delivery hydraulic pump and tank unit.

Micromatic fixturing on this application embodies two work-holding stations. This permits the loading of a second part while the first part is being Microhoned. A hydraulic mechanism indexes the finished part to the unload station and rotates the unhoned part into the machining position. The fixturing is adjustable for work of various diameters and lengths. The machine and fixture controls are interlocked for automatic operation.

Circle Item 577 on postcard, page 199

Lapointe "Eager Beaver" Broaching Machine

The Lapointe Machine Tool Co., Hudson, Mass., has introduced a bench-size broaching machine which will sell at a moderate price so as to encourage many firms to use broaching for operations formerly performed in some other way. This product, called the "Eager Beaver," is a small, pull-down type machine of midget size rated at 1 1/2 tons at a broaching speed of 5 feet per minute, and 3/4 ton at 10 feet per minute. It is built with a 12-inch stroke. Standard equipment comprises two cutting speeds and a mechanism for adjusting the stroke. The tooling, coolant system, and electrical equipment are extra.

Of bench size, this unit is only 31 inches wide, 20 inches front-to-back, and 34 inches high. The hole in the draw-head is 1 1/2 inches in diameter and the hole in the platen, 5 inches in diameter. The platen dimension (working surface) is 17 by 18 1/2 inches. The weight is 500 pounds. The machine is self-contained, readily portable, and can be plugged into any 110-volt outlet. It has a mechanical screw type drive with all moving parts lubricated and is designed for an automatic broach puller and coolant. Although small and compact, this unit is eminently suited to the broaching of small missile parts to extremely close tolerances. Such parts as lock-cylinder barrels, various slots, and other internal applications are broached easily on this machine, and in certain instances, external and surface broaching can be performed satisfactorily.

Circle Item 578 on postcard, page 199

Elox Tool for Electronic Three-Dimensional Machining

The Elox Corporation of Michigan, Troy, Mich., has announced an RP-100 series of electrical-discharge machine tools. Designed for use where precision is essential, this equipment is being used for the rapid production of extrusion dies, powdered-metal dies, cold-heading, blanking, as well as multiple-piercing dies and three-dimensional cavities. The series can use any Elox vacuum tube or RC power supplies.

The machines in this series are

"Eager Beaver" bench-size broaching machine

Elox electrical-discharge machine tool

equipped with electrical-mechanical power feed or hydraulic power feed. Precision locating devices and precision electrode-holding devices can be furnished. The work-table surface is 7 by 17 inches or 12 by 18 inches and has precision cross-feed. It can be supplied with end-measuring rods or optical measuring devices as required. The quill is 3 3/4 inches in diameter and has a vertical travel of 10 inches. A complete dielectric oil system consisting of reservoir, pumps, and filters is built into the base of the machine. These machines are constructed to JIC standards, require a floor space of only 27 by 61 inches, and weigh 3500 pounds.

Circle Item 579 on postcard, page 199

Warco Gap Press Equipped with Roll Feed

The Federal Machine & Welder Co., Warren, Ohio, has announced a No. 60-1-14CG welded-steel, open-back, single-crank, flywheel type gap press with a capacity of 60 tons. It operates at speeds from 75 to 200 strokes per minute. It has bronze-lined crankshaft bearings and gibways. The flywheel runs on anti-friction bearings. An air counterbalance is provided for the slide. Equipment includes a recirculating oil lubricating system, a rotary limit switch, and a pneumatic clutch and brake unit. The feed shown is a double-roll type for 0.060-inch-thick material, 12 inches wide. Feed-length range is from 0 to 12 inches. Maximum feeding speed is 1200 inches per minute.

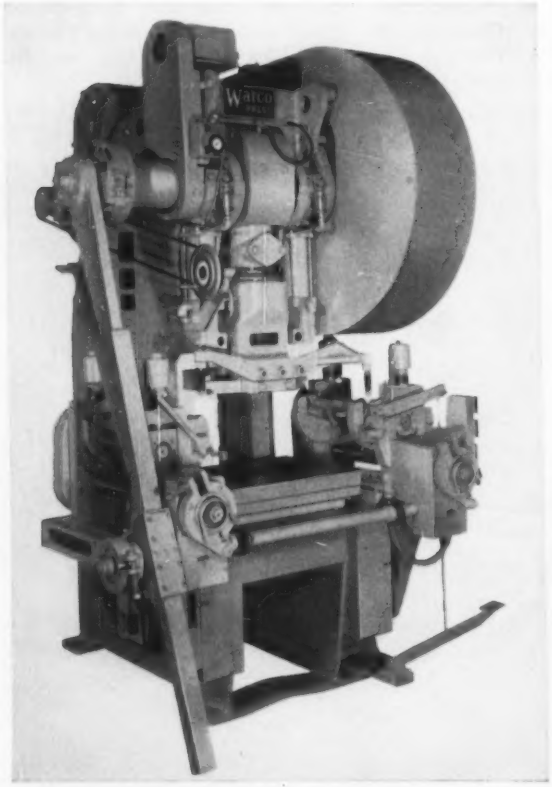
Circle Item 580 on postcard, page 199

Automated Cylinder-Sleeve Honing Machine

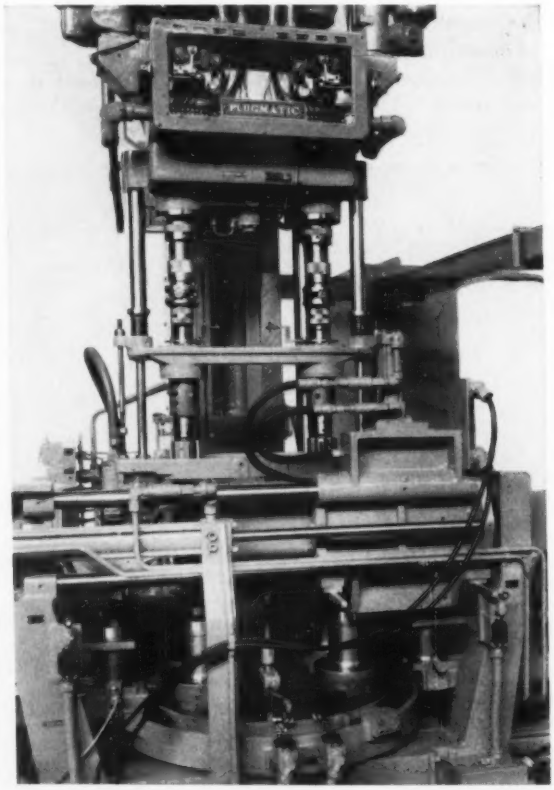
A BarnesdriL Model No. 307-2 vertical type honing machine and a special fixture assembly built by the Barnes Drill Co., Rockford, Ill., made possible complete automation in the honing section of a cylinder-sleeve production line. The cast-iron cylinder sleeves are honed at the rate of 144 parts per hour at 80 per cent efficiency. In honing, 0.002 to 0.004 inch of stock is removed from the bored hole to produce a bore that is accurate within 0.0005 inch for roundness and taper and to hold bore sizes consistently within a tolerance of 0.0007 inch. A 25 to 35 micro-inch finish is applied to the 3.150-inch inside diameter by 5.393-inch-long bore of the cylinder sleeve.

The honing machine is arranged with twin-cylinder, hydraulic reciprocation and has controls for infinitely variable reciprocation rates from 10 to 75 feet per minute. Included with the two-spindle reciprocating head are electronic hone expansion and Plugmatic automatic bore-to-bore sizing.

BarnesdriL electronic hone expansion on the No. 307 honing machine features automatically controlled rapid expansion and collapse, electronically measured and



Gap press equipped with roll feed announced by Federal Machine & Welder Co.



BarnesdriL vertical honing machine equipped for processing cylinder sleeves

infinitely adjustable hone feed, automatic compensation for stone wear, and individual feed for each spindle. Plugmatic sizing control units allow independent spindle-honing action until bore size is reached.

The BarnesdriL hydraulically operated automatic fixture-assembly controls are electrically interlocked with machine controls to reduce operator functions and minimize cycle time. Accidental misplacement of parts or interruption of supply will cause immediate shut-down of the machine.

A two-position, rotary index-table 18 inches in diameter is mounted on a non-adjustable fixture table. This table also supports two clamping mechanisms and the transfer-carriage assembly. The index-table rotates through 180 degrees and is equipped with four fixture sub-assemblies which have full floating type compensating adapters.

Circle Item 581 on postcard, page 199

Steelweld Speed-Draw Press

Steel shells for air-conditioning compressor units are stamped in a single draw from blanks 22 3/4 inches in diameter at the rate of one hundred in a sixty-four-minute period on a 400-ton Steelweld Speed-Draw press made by the Cleveland Crane & Engineering Co., Wickliffe, Ohio. The finished shells are 11.35 inches in diameter and 11 inches deep. The material is 0.1644-inch draw type steel. All dimensions are held accurately to specifications, and the stampings are smooth and uniform.

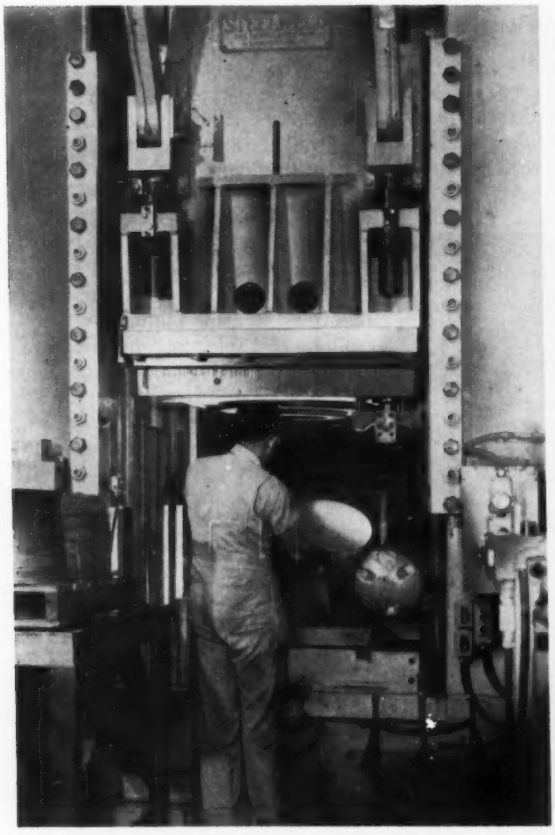
The shells are made in two different lengths which are welded together to form a complete compressor housing. The upper or longer shell is drawn through die rings and ejected from the dies onto a conveyor below the machine. This draw is greater than a 50 per cent reduction from blank size. The lower, shorter shell is removed from the draw-and-form die by the operator and placed onto a tool at the right front of the press which punches a hole in the side.

Circle Item 582 on postcard, page 199

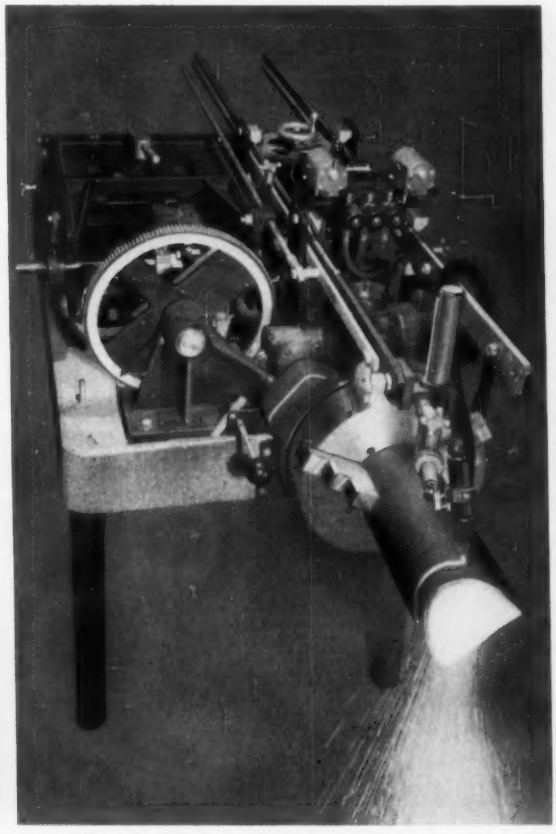
Automatic Contour Cutter

An improved automatic contour-cutting machine is announced by the Steffan Mfg. Corporation, Salem, Ohio. This machine is reported to save up to 75 per cent in time and material in joining pipe and fabricated parts. It is designed to practically eliminate the use of forged fittings. Initial setup takes as little as fifteen seconds. At a cutting rate of 20 inches per minute, a 6-inch aluminum pipe can be contoured in only twenty seconds.

Pipe is clamped into a three-jaw chuck and pertinent information fed into the controlling mechanism. Pushing a button activates the action, and the most complex contour is automatically cut without the



Steelweld double-action Speed-Draw press



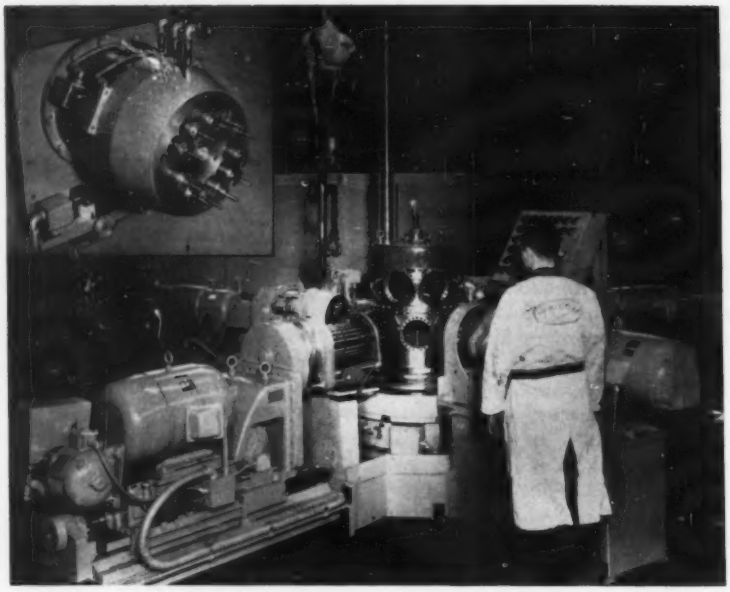
Steffan automatic contour-cutting machine

use of templates, layouts, or patterns.

Sections requiring straight, mitered, or contoured ends are quickly prepared with proper bevels for welding. The cutting head is equipped with an oxy-acetylene torch for cutting carbon steel or a Linde Heliarc for cutting aluminum, stainless steel, copper, cast iron, and high-alloy steels.

Optional equipment widens the range of uses. A companion piece, operating on the same principles, is available for cutting holes, circles, and ellipses. Various models of the cutter allow handling pipe from 2 to 24 inches in diameter.

Circle Item 583 on postcard, page 199



Zagar machine equipped with gearless heads for processing crankcases

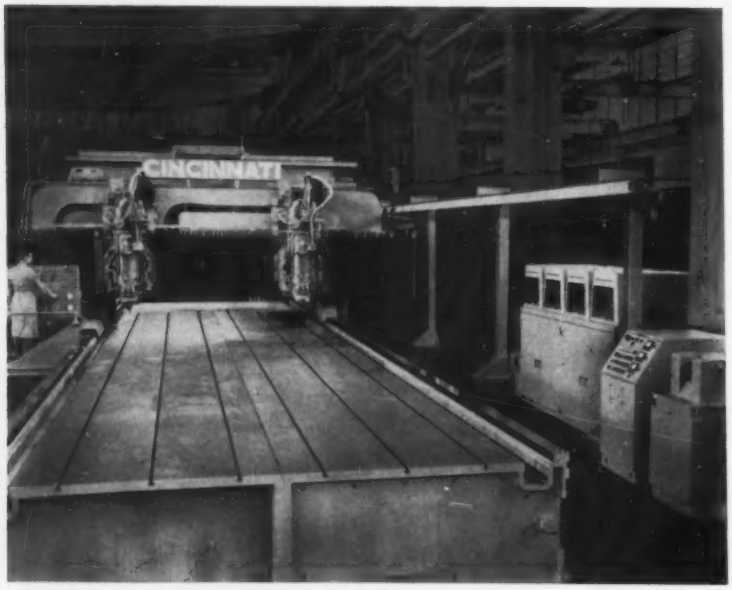
Machine for Counterboring, Drilling, Reaming, and Tapping Crankcases

A machine designed to drill, ream, tap, and back-counterbore crankcases has been announced by Zagar, Inc., Cleveland, Ohio. The back-counterboring operation is performed on the internal face of the crankcase by a special spindle. This spindle brings the tools automatically into the cutting position and allows them to be rotated in the case to complete the counterboring operation. Altogether twenty-one holes are drilled, reamed, counterbored, and tapped at each of the nine cylinder-head positions. One bank of the crankcase is processed at each pass.

Circle Item 584 on postcard, page 199

Numerically Controlled Wing-Skin Milling Machine

A large, numerically controlled, wing-skin milling machine recently supplied to the aircraft industry by the Cincinnati Milling Machine Co., Cincinnati, Ohio, is equipped with two independently powered milling heads driven by 50- to 100-hp motors. The machine may be controlled in three ways: first, by finger-tip hand control, as shown in the illustration; second, by power control with longitudinal and cross-feed and power rapid traverse, for straight cuts; and third, by card or tape numerical control, for automatic three-axis milling and selection of one or two heads.

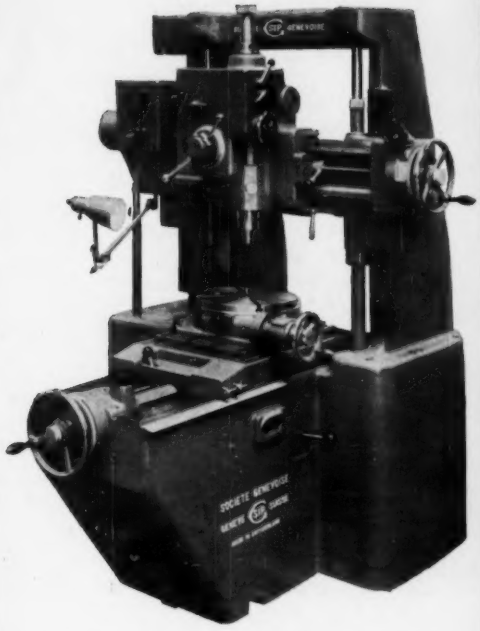


Numerically controlled wing-skin milling machine brought out by the Cincinnati Milling Machine Co.

Each milling head is equipped with a manual, two-direction swivel-and-lock arrangement, for angular cuts parallel to table T-slots or cross-rail. The machine can be set up to mill two identical parts at the same time, each up to 5 feet wide; a pair of right-hand and left-hand parts, each up to 5 feet wide; or one part the full working width of the table, using one head. Accuracy and finish are said to be of an exceptionally high order, aided by an automatic backlash eliminating feature and anti-friction gantry traverse on hardened ways. The working surface of the table is 12 by 45 feet.

Circle Item 585 on postcard, page 199

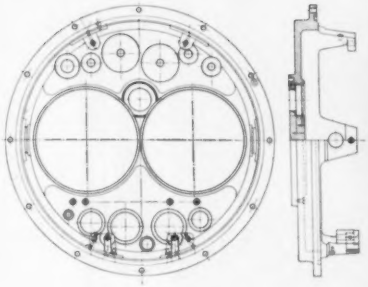
(This section continued on page 190)

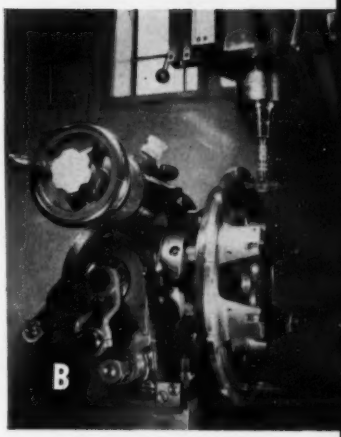


SIP No. 3K JIG BORING MACHINE
Send for Catalog 1173

Illustrated is the machining of a magnesium casting for an electronic unit . . . (A) drilling, boring and counterboring 37 holes, 62 diameters ranging from 0.255″ to 5.125″ . . . (B) drilling, boring and counterboring 11 holes, 16 diameters ranging from 0.100″ to 0.787″. Here's the record:

MACHINING TIME (A).....8 HOURS, 15 MINUTES
MACHINING TIME (B).....2 HOURS, 0 MINUTES





How's that for Production!

The machine that does it is the SIP No. 3K Jig Boring Machine. It has what it takes—ease of operation, increased generous range and capacity, plus the basic Precision that is SIP—to finish critically sensitive jobs like this so fast and so well! SIP quality and precision cost you no more.

and how's this for Accuracy?

HOLE DIAMETERS HELD TO +0.0004″, −0
CENTER DISTANCES HELD TO +0.00025″, −0

SIP makes Precision Production Practical & Profitable

AMERICAN SIP CORPORATION
100 EAST 42nd STREET, NEW YORK 17, N. Y.

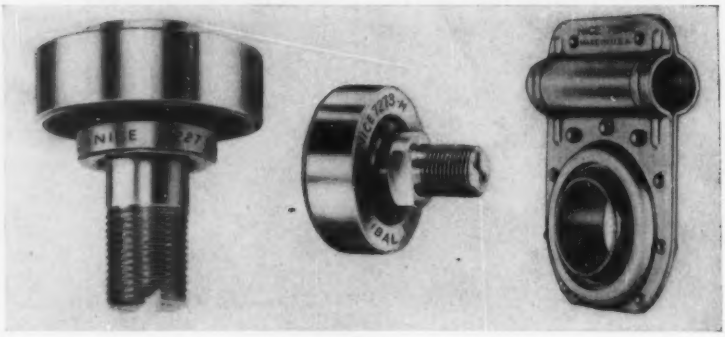
Since 1926 all SIP Machines delivered to U.S.A. and Canada have been calibrated in the INTERNATIONAL INCH (1″ = 25.4 mm).

Ball Bearings with Support Assemblies

The Nice Ball Bearing Co., Philadelphia, Pa., has brought out a line of ball bearings designed primarily for tractor and farm-implement applications but which have a variety of industrial applications. Included in a wide variety of sizes are wire-guide and plunger-guide rollers, cam followers, belt idlers, as well as tine-bar bearings and power take-off support assemblies.

The "Unibal" design features solid inner and outer raceways with deep, unbroken grooves and a maximum number of balls. Several of the units also incorporate effective seals especially developed to meet the rigid requirements of certain applications in the farm-implement field.

At the left in the illustration is shown a hay-rake tine-bar bearing-and-bolt assembly. A ball-bearing plunger-guide roller for a hay bailer is shown in the center view. At the right is shown a power take-off support bearing assembly.

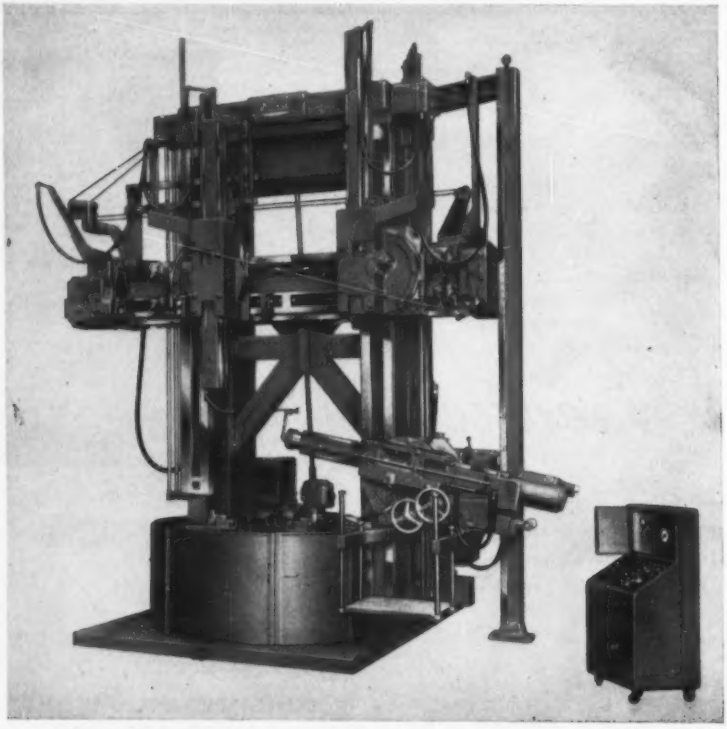


Typical ball-bearing assembly units introduced by the Nice Ball Bearing Co.

Circle Item 586 on postcard, page 199

Custom-Designed Boring Mill for Missile and General-Duty Machining Work

The American Steel Foundries, King Machine Tool Division, Cincinnati, Ohio, recently built and installed a 72-inch King vertical boring and turning machine in a leading aircraft plant that will be used in connection with the missile program. It is designed to retain all the general-purpose facilities of the standard-model King machines and to include, among its many special features, a 134-inch working height under rail, extended rams, and a swiveling type side-head arranged for tracer-controlled turning and grinding operations. Other features are a grinding attachment with multiple-speed, precision motorized spindle extending through side-head ram and arranged to receive interchangeable quills, (the attachment includes balancing type wheel holders and wheel guard with exhaust outlet); and a three-position toolholder for the side-head, which can be readily interchanged with grinder quills for turning operations.



King boring mill adapted for missile and general-duty machining work

Additional features consist of an operator-carrier platform attached to side head; a console control system; an electronic, two-dimensional, 360-degree tracer mounted on side head; and a template holder arranged to support templates of the type required for work-pieces utilizing the full capacity of the machine. Universal adjustment is provided for the tracer head.

The electronic, two-dimensional, 360-degree tracer is mounted on top of the rail to provide maximum work clearance above the table. Positioning controls for the stylus head are provided for operator convenience. Constant surface-cutting-speed attachment and constant chip-thickness controls are applied to both tracer heads. Coolant is conducted through rail-head rams.

Circle Item 587 on postcard, page 199

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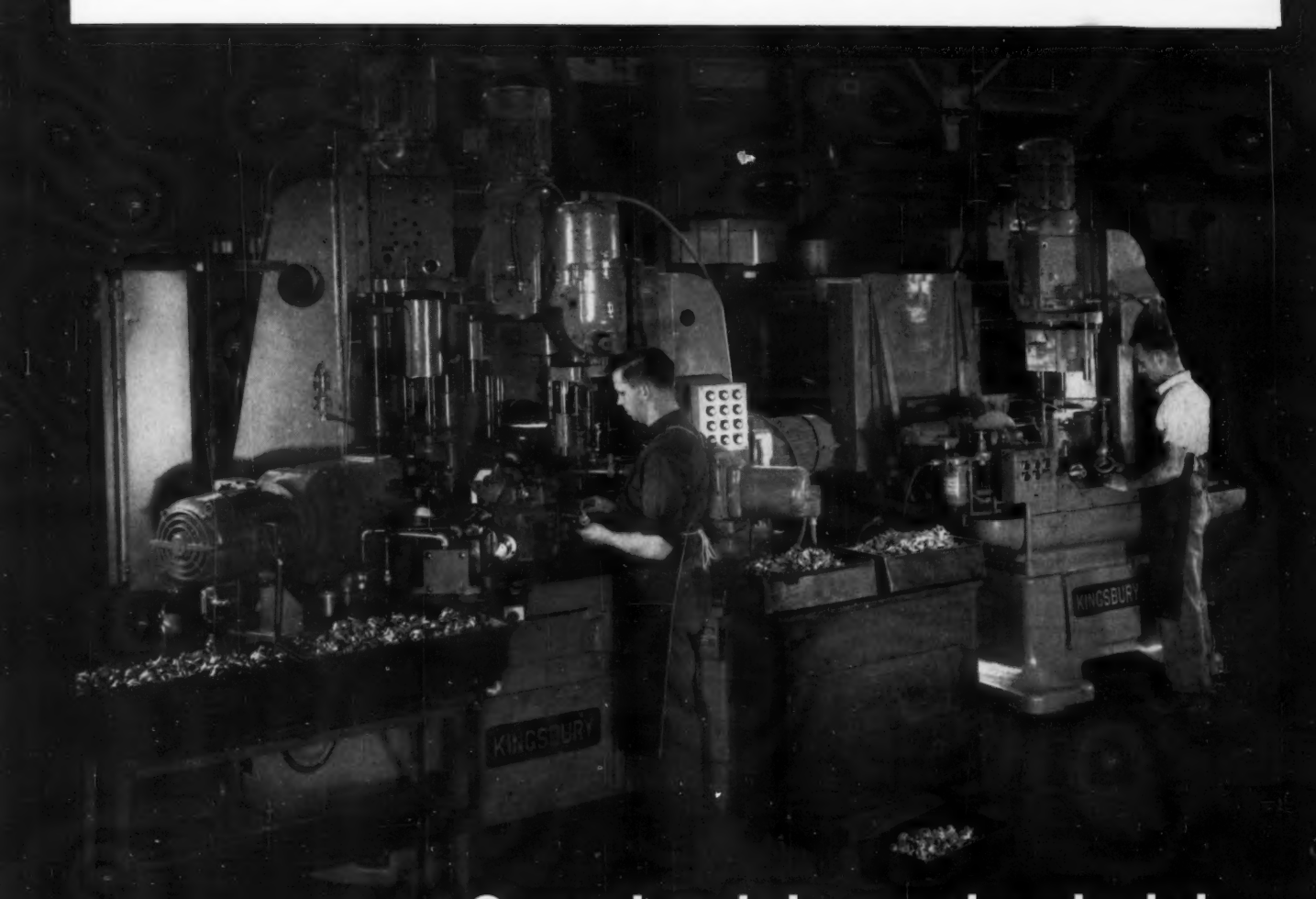


Complex job–or simple job

Kingsburys save money on both

600 valve castings per hour gross with a 14-spindle indexing machine

At the left is high production with a variety of tools — five combination tools, two drills, a hollow mill, a recessing tool for the undercut, a counterbore and three taps.

A 30-inch index table holds seven fixtures. Steel jaws in each fixture hold two parts, one in front for the first chucking and one in back for the second. A spring-loaded ram clamps the parts and an air cylinder unclamps them.

Nine self-contained units perform the operations. Seven have single spindles. Two vertical units have multi-spindle heads; each operates at two stations and in both chuckings.

The machine also handles a part with another tapped hole. The units cycle in 4.5 seconds, and the table indexes in 1.5 seconds, so a part can be finished every 6 seconds.

325 aluminum housings per hour gross with a 6-spindle non-index machine

The machine at the right has one fixture. Clamping is manual. Two opposed units drill two holes in line. To avoid tool clash one unit cycles, then a cam-controlled valve trips the other. A vertical unit taps four holes.

Kingsbury machines save money because they produce uniform parts that gage. Good basic design and rugged accurate construction mean few rejects and little down time.

Kingsbury Machine Tool Corporation, Keene, N. H.

KINGSBURY MULTI-UNIT AUTOMATICS

BRASS VALVE BODY

ALUMINUM HOUSING

Mechamatic Dual-Spindle Unit for Deburring and Finishing Parts

The Mecha-Finish Corporation, Sturgis, Mich., has added an MM-1-2 high-speed, dual-spindle unit to its line of fixtured deburring and finishing equipment. This unit can be used for the production of many different parts required in small quantities, as well as for high production of a single part.

The parts are mounted on air-operated spindle fixtures, which are submerged while rotating in a fluid abrasive mass. This action simulates that of a form-fitting grinding wheel regardless of the shape of the work-piece and travels at the rate of approximately 2000 surface feet per minute. The machine illustrated operates at a fifteen-second time cycle, will produce 240 pieces per hour per spindle at 100 per cent efficiency, and has a capacity for handling parts up to 8 1/4 inches in diameter. The Mechamatic process is completely automatic and controlled except for loading and unloading of the parts or work-pieces.

Mechamatic fixtured deburring and finishing machine

Circle Item 588 on postcard, page 199

Automatic Indexing Machine for Processing Refrigerator-Compressor Housings

A high-production machine at the plant of one of the largest manufacturers of major appliances is currently performing seventy-four distinct operations automatically on one- or two-cylinder refrigerator-compressor housings. Manufactured by the Morris Machine Tool Co., Cincinnati, Ohio, this eighteen-station, center-column machine utilizes an 84-inch hydraulic indexing table.

The seventy-four spindles are mounted on three, 8-inch, way type units, eight No. 2 Cam-Matic drill units, and fourteen Air-Oil-Matic drill units. By incorporating these standard production units, the equipment eliminates model change-over problems. Fast, easy realignment of the machine is possible for product-model changes, for completely new models, or for other types of products.

Operation is completely automatic, as the machine drills, counter-bores, spot-faces, bores, reams, and taps housings. The machine operator merely loads unfinished pieces into air-powered clamping fixtures and unloads completed parts at the rate of one exchange each thirty seconds. The fixtures, which accommodate either one- or two-cylinder housings, utilize an expanding arbor to locate

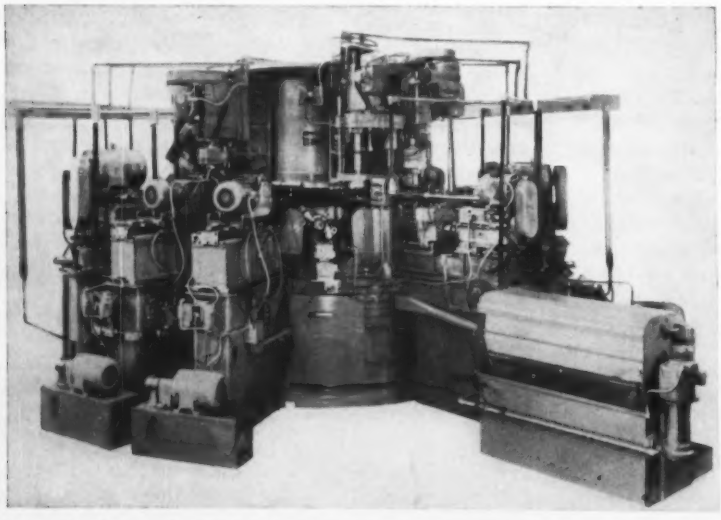


Fig. 1. Morris automatic indexing machine equipped for processing refrigerator-compressor housings

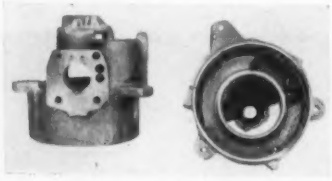
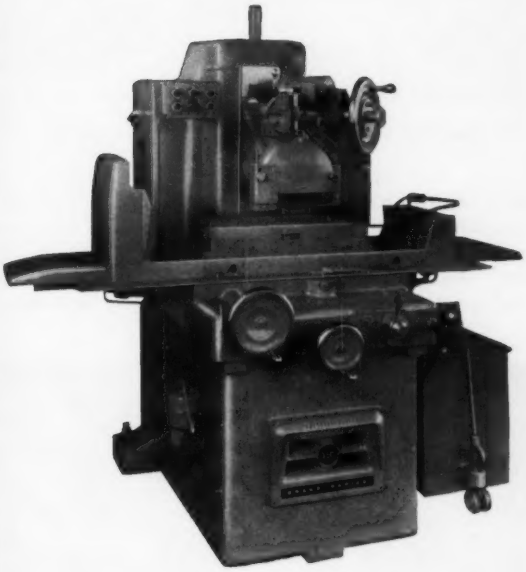


Fig. 2. Work processed by machine shown in Fig. 1

NEW *from* GRAND RAPIDS

No. 350 PRECISION TOOL ROOM TYPE HYDRAULIC FEED SURFACE GRINDER

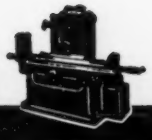


and just look at all these features:

- Powered vertical movement of wheel head*
- Instantly variable hydraulic table speed
- Greased-for-life precision ball bearing spindle with two speeds for long wheel life
- Head carried on protected pre-loaded ball bearing ways
- Equipped with Vickers vane type pump and our own control valve for infinite longitudinal table speeds from 5″ to 120′ per minute
- Variable speeds hydraulic cross feed and continuous cross feed
- Rugged, one-piece casting column and base for permanent rigid alignment
- Ultimate in accuracy with micro inch finish at production speeds

**Automatic downfeed available as optional feature*

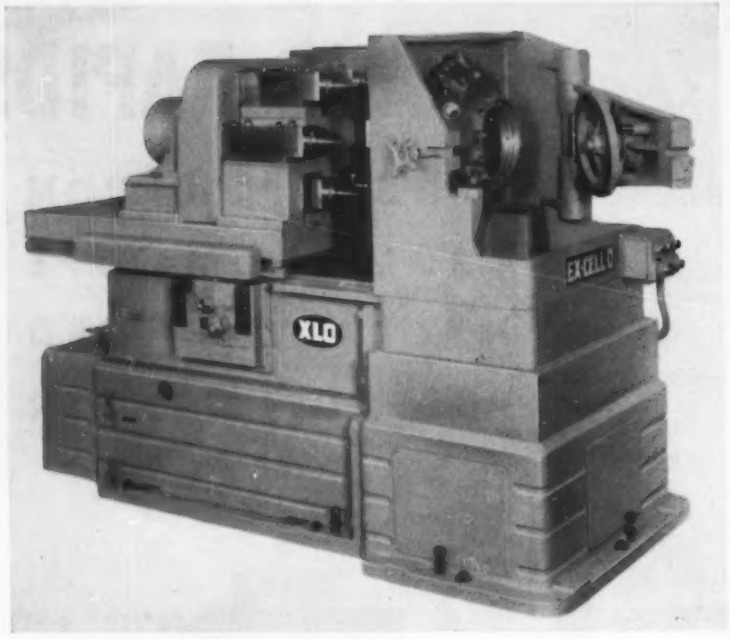
For full details, just send a note on your letterhead.



GALLMEYER & LIVINGSTON

GALLMEYER & LIVINGSTON CO.
305 Straight Ave., S.W., Grand Rapids, Mich.

For more data, circle this page number on inquiry card



One-way precision boring machine for boring six holes in aircraft part

the part with respect to a previous roughing operation.

Each of the standard Morris drill units has independent feeds and speeds, permitting adjustment without affecting the entire machine. Easy access to all tools is provided by the efficient mounting of the individual units.

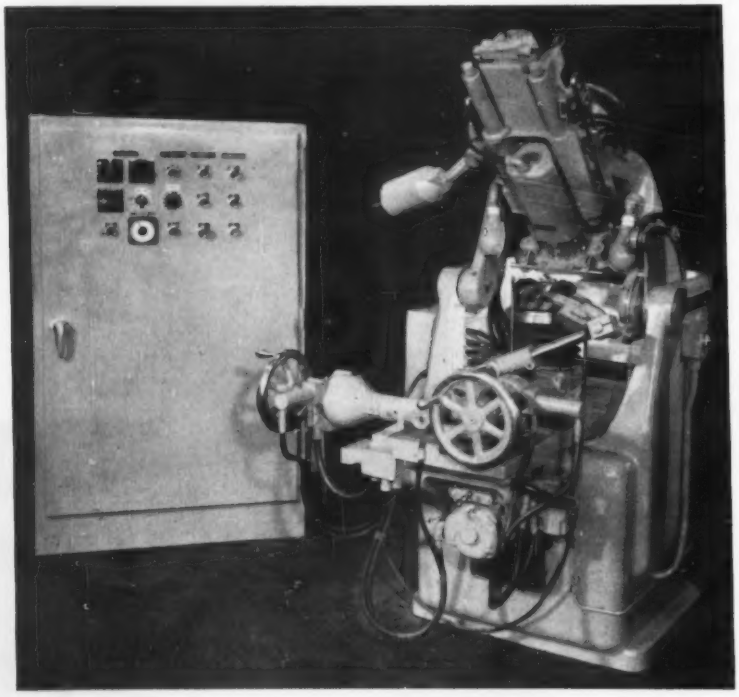
Circle Item 589 on postcard, page 199

Precision Boring Machine for Processing Magnesium Aircraft Part

A one-way, precision boring machine, built up almost entirely from its standard machine components, has been brought out by the Ex-Cell-O Corporation, Detroit, Mich. Standard components include a way unit to support six Ex-Cell-O precision spindles mounted on a slide for processing a magnesium aircraft part. The way unit is bolted to a standard end section on which the work-holding fixture is located. This method of construction insures low initial cost plus the added advantage of versatility—units may be easily rearranged to suit product changes. The Ex-Cell-O standard way unit is self-contained.

In operation, the slide feeds forward in rapid traverse and then semifinish-bores and chamfers five holes and finish-bores and chamfers one hole. Hole locations are held to plus or minus 0.001 inch and the finish-bored hole is held to plus or minus 0.0005 inch on the diameter. The precision aircraft part is rapidly loaded and clamped in the manually operated fixture.

Circle Item 590 on postcard, page 199



Semi-automatic cutter grinder announced by Ingersoll Milling Machine Co.

Ingersoll Semi-Automatic Cutter Grinder

As a companion to its recently announced automatic cutter grinder, the Ingersoll Milling Machine Co., Rockford, Ill., is offering a semi-automatic cutter grinder. These grinders may be obtained either as complete new units, or by having power-control parts added to manually actuated Ingersoll cutter grinders built in recent years.

The semi-automatic grinder is designed to add the advantages of power-controlled grinding to those already inherent in the design of the 30-inch Ingersoll general-purpose grinder. Both grinders are parts of a planned program to provide each metalworking shop with equipment resulting in the lowest possible tool costs. The program also includes the development of new types of Ingersoll inserted-blade milling cutters.

Circle Item 591 on postcard, page 199

(This section continued on page 196)

56

S&F GEAR TESTERS CAN'T BE WRONG!

AND THEY NEVER ARE— AT ECLIPSE-PIONEER

Division of Bendix Aviation Corp., Teterboro, N. J.

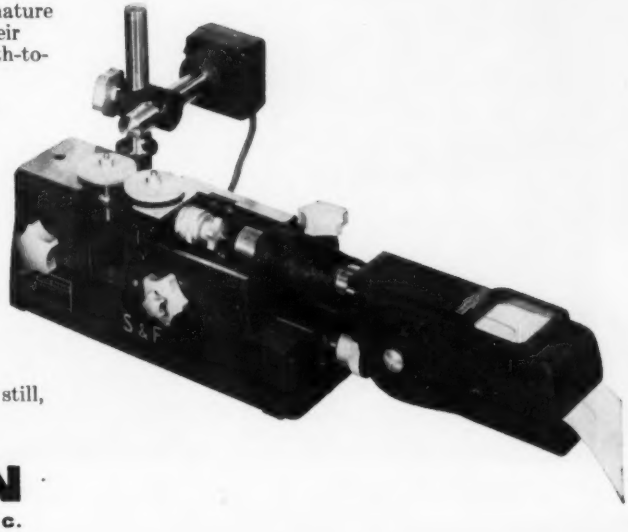
Turning out Precision Class 3 Gears is almost second nature to Eclipse-Pioneer. These are the gears that go into their famous directional gyros for aircraft and missiles. Tooth-to-tooth error, .0002". Total composite error, .0003".

The first S & F Tester bought by Eclipse-Pioneer four years ago told them what they wanted: no other gear checker was so accurate, so easy to use.

So they kept buying them. For floor after floor. Section after section. Year after year. Now, 56 S & F Testers act as guardians of precision all over the plant—assurance that Eclipse-Pioneer gears really hold to the tolerances called for.

Would *you* like to be assured that the gears you make—or buy—are as accurate as they're supposed to be? Check them on an S & F—guaranteed to repeat within .00001"—as 359 plants now do.

Ask us to send you the name of a nearby user. Better still, may we demonstrate the S & F for you?



KO KURT ORBAN COMPANY, INC.
42 Exchange Place, Jersey City 2, N. J.

For more data, circle this page number on inquiry card

Snyder Transfer Machine for Line-Boring Engine Blocks

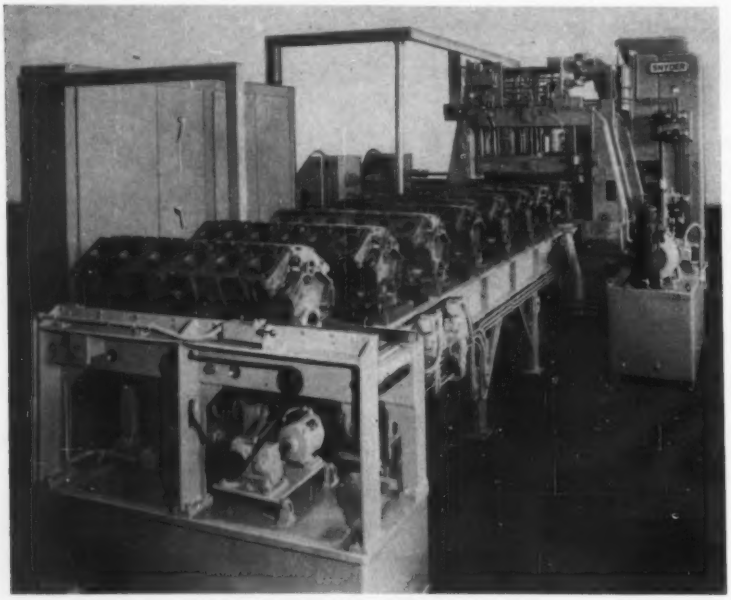
A seven-station transfer machine for boring and precision line-boring large, cast iron V-12 truck engine blocks at the rate of thirty-one pieces per hour, at 100 per cent efficiency, has been built by the Snyder Corporation, Detroit, Mich. This 35-foot long, hydraulically operated, electrically controlled unit receives blocks from the factory conveyor. The blocks are automatically loaded into the equipment and transferred through the various idle and machining stations by a walking-beam type of transfer mechanism. They are automatically returned to another factory conveyor after being processed.

The crankshaft and camshaft bearings are line-bored simultaneously in two stations of the machine. Way type machining units with a 60-inch travel retract the long boring-bars so that the blocks can be loaded into the fixture at the machining stations. Each boring-bar is supported by several fixed bearings in the fixture during boring. This requires an unusual fixture and transfer-mechanism design to enable the blocks to be positioned over the supports for the crankshaft-bearing boring-bar. The bearing supports for the camshaft-bearing boring-bar are lowered into the block as it is clamped down in the machining position.

At Station 1, the blocks are automatically loaded into the transfer position from the factory conveyor. They are probed in Station 2. In Station 3, a vertical-way type unit performs a rough-boring operation on the distributor hole. Simultaneously the horizontal-way type unit with the 60-inch stroke rough-bores the camshaft bearings and the crankshaft bearings, which are approximately 2 1/4 and 3 3/8 inches in diameter, respectively.

Station 4 is idle. The crankshaft bearings are semifinish-bored in Station 5 at the same time that the camshaft bearings are finish-bored to receive a bearing insert. Station 6 is an idle station. Station 7 is essentially a storage unit that extends the machine to meet the factory conveyor onto which the blocks are automatically unloaded.

Circle Item 592 on postcard, page 199



Snyder seven-station transfer machine that bores and precision line-bores large V-12 engine blocks

Monitor Measuring Machine

A combination instrument, known as the "Go-Devil Monitor," that serves as a comparator, measuring machine, and dial-indicator checker is now being manufactured by the Go-Devil Instrument Co., Poughkeepsie, N. Y. As shown in the illustration, the Monitor consists of a rugged base with column and accessories for mounting a dial indicator. A master-setting spindle of approximately the same diameter as the spindle of the dial indicator is located in the center of the serrated work-table of the Monitor. The master-setting spindle and the spindle of the dial indicator are located on the same vertical center line. A handwheel accessible through openings in the base is used to raise this spindle any desired amount above the surface of the work-table.

"Go-Devil Monitor" combination measuring machine

The height of the master-setting spindle above the table is read on a scale having 0.025-inch graduations, which can be seen through the vertical slot and the horizontal setting dial in the base that has 0.0001-inch graduations. The setting-dial graduations appear in an arc-shaped slot in the base.

When used as a comparator, the dial indicator is set to zero against the end of the master-setting spindle. At this point, the accuracy of the indicator may be checked at the high and low limits. The setting spindle is then lowered below the serrated work-table on which the part to be checked is placed.

When employed as a measuring machine, the work-piece is placed on the serrated table and the dial indicator set to zero with its gaging end in contact with the work-piece. The work-piece is then re-

(Continued on page 206)

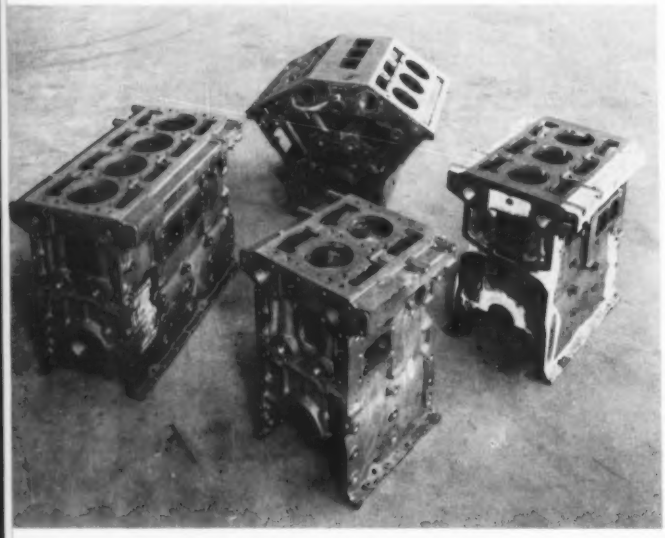
Tomorrow this transfer machine will work on a different part

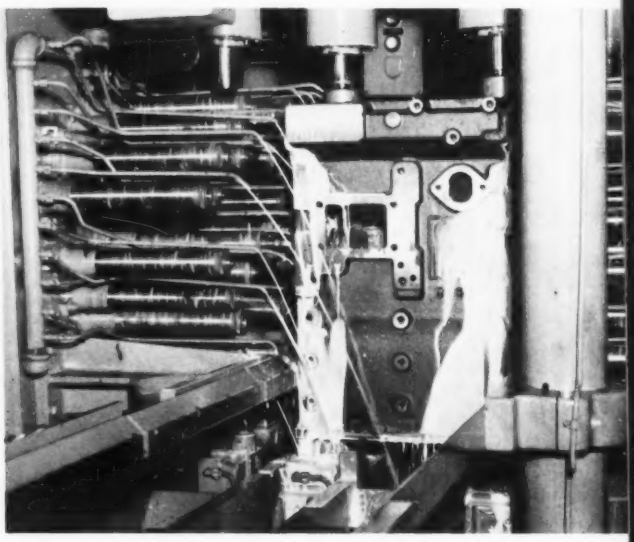
. . . Natco flexible automation can speed your production too.

(see other side)

FOUR PARTS OR ONE CAST IRON OR ALUMINUM

It's all the same to these Natco transfer machines





Look at these four diesel engine blocks. Each is a different machining problem, yet one line of three Natco Holeways does the complete job on them all.

Natco designing skill shows in the easy way these machines accept the four different blocks, either cast iron or aluminum. In only 40 working stations these machines can perform 485 operations. Ingenious transfer devices enable all faces of the workpiece to be machined. Versatile building block construction keeps the line ready for conversion when models change.

Natco Holeway No. 1 is capable of performing 173 different operations—drilling, rough boring, reaming, chamfering and counterboring.

Holeway No. 2 does 139 similar operations, including end milling of these same engine blocks.

Holeway No. 3 performs 173 tapping operations. These machines work on all the external faces of the blocks, including the angular faces of the V-block.

Product mix problems? Think what a truly flexible Natco like this could do for them! Weigh the value of a Natco which accepts a variety of parts and decides what work to do on them. Even if your production won't justify this ultimate in automatic machining—Natco builds drilling, boring, tapping, facing, reaming, chamfering machines in all degrees of automation.

Standard or special, if your machining job is holes, Natco makes the machine to do it better. Let our representative show you. Call him today.

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NEW CATALOGUES

CAMS AND SHAFTS—Meehanite Metal Corporation, New Rochelle, N. Y. Bulletin No. 39, entitled "Meehanite Cams, Camshafts and Crankshafts," which devotes itself primarily to application problems solved by the company's products. Copies may be obtained by request on company letterhead from Meehanite Metal Corporation, 714 North Ave., New Rochelle, N. Y.

MICROSCOPE—Opto-Metric Tools, Inc., New York City. Catalogue on the Model UWM universal toolmaker microscope of Leitz make, partly illustrated by exploded views of unusual optical features. A copy may be obtained by request on company letterhead from Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y.

AIRCRAFT TUBING—Ohio Seamless Tube Division of Copperweld Steel Co., Shelby, Ohio. 70-page revised and updated version of the company's Technical Handbook A-2, which describes seamless aircraft tubing and carbon and alloy steels. It covers definitions, military and AMS specifications, sizes, tolerances, machining, heat-treating, and properties. Distribution of this handbook will be confined to those individuals and firms actively engaged in product design, procurement, and production. **501**

PIPE WELDING—Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York City. Booklet (Form ADR 118), incorporating two technical articles on small pipe welding, written by A. N. Kugler, chief welding engineer, Airco. They are entitled "Fabrication of Small Piping by Welding and Brazing" and "Designing for Welded Systems of Small Size Pipe," and appeared originally in successive issues of the magazine "Air Conditioning, Heating and Ventilating." **502**

MACHINERY REPLACEMENT — Heald Machine Co., Worcester, Mass. Fold-out brochure giving full details on how replacement of old machines paid off for six manufacturers. It points out that there is a mathematically right time to replace a machine tool—when the replacement works out to the user's best advantage production-wise and investment-wise. **503**

POWER SAW—DoALL Co., Des Plaines, Ill. Brochure describing and illustrating the cutoff capacity and operating ease of the Model C-24 DoALL power saw. Among the many features and improvements are a new chip-disposal system; a redesigned feed control mechanism which increases blade life 200 to 500 per cent; an improved drive system to supply adequate power for new accessories; and a new coolant system. **504**

CARBIDE SAWS—Disston Division, H. K. Porter Co., Inc., Philadelphia, Pa. Catalogue describing carbide-tipped saws. Descriptions on how to select the proper type carbide saw for a particular use, a selection guide for proper diameter, number of teeth and saw speed, plus care and handling of the saws are included. It is part of a series. Bound sections as well as individual pages on the saws are available. **505**

METAL-CLEANING GUIDE — Magnus Chemical Co., Garwood, N. J. Bulletin M240, entitled "Your Guide to Effective, Economical Metal Cleaning," a series of charts in handy file-folder form, giving information on how to simplify the task of selecting the correct cleaning method and chemical for the various metals and

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soils which are likely to be encountered in the metalworking and finishing fields. Typical problems are covered. **506**

ARMY MISSILE PRODUCTION—Wassell Organization, Inc., Westport, Conn. Booklet entitled, "To Speed Up Operations," describing how Wassell Produc-Trol—the peg-and-tape control system invented by F. Lloyd Wassell at the start of World War II—today speeds design and production of Jupiter and Redstone IRBM's and other Army space products at Redstone Arsenal, Ala. **507**

FORGING — Chambersburg Engineering Co., Chambersburg, Pa. Bulletin No. 87-L-9 entitled "The Automatic Production of Forgings in Closed Dies," which describes the newer applications of the "Impacter" in the design of machinery for the forging industry. It also outlines the various considerations that must be dealt with in the mechanization of the forging process. **508**

DRILLING AND REAMING—Fox Engineering Co., Jackson, Mich. Two circulars, describing two drilling and reaming machines—the Fox L-66-H, a vertical multiple-spindle drilling machine available with either general-purpose adjustable-spindle heads or single-purpose fixed-center heads; and a Fox E-60-H two-way horizontal way type drilling and reaming machine. **509**

FLOW CONTROL—Air Reduction Sales Co., A Division of Air Reduction Co., Inc., New York City. Catalogue (Form ADC 888), describing the company's line of gas-flow control equipment for argon, helium, and carbon dioxide. The operation and various applications for this equipment are described, and a number of photographs of each type are included. **510**

FINISHING—Roto-Finish Co., Kalamazoo, Mich. Catalogue on precision mechanical finishing and automatic finishing processes. Included are descriptions of various conventional models, as well as the Roto-Matic automatic finishing machine, and the newly developed Vibratron, which employs a vibratory abrasive action. **511**

TAPPING AND DRILLING—Drillmation Co., Inc., Center Line, Mich. Folder called "The 'Hole' Issue on Holes," explaining how and why precision tapping, drilling, and gun-boring are being used to reduce the cost of ordinary metal-cutting operations using Tapmation, Drillmation, and Boremation power units. **512**

WIRE-STRAIGHTENING MACHINE — Vaughn Machinery Co., Cuyahoga Falls, Ohio. Bulletin No. 751, describing Motomatic No. 75, a wire-straightening and cutting machine with 3/4-inch capacity. It is specially designed to deliver uniform lengths of straight, precision-cut wire at variable speeds up to 300 fpm. **513**

SPROCKETS AND CHAIN DRIVES — Cullman Wheel Co., Chicago, Ill. 88-page engineering and stock catalogue No. 60 on sprockets and chain drives. Full details on Cullman's 1300 different stock sprockets and its various types of roller chains, along with technical data and chain-drive engineering information, are included in the booklet. **514**

GEAR DATA—Engineering Data Supply, Los Angeles, Calif. Bulletin describing tables of instrument gear data, giving complete data for all numbers of teeth from 10 to 400 in 64, 72, 80, 96, 120, 160, 180, and 200 diametral pitches, including all engineering data for enlarged pinions from 10 to 17 teeth. **515**

BORING TOOLS—Davis Boring Tool Division, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Catalogue No. D-510, presenting a complete new pricing structure for block type boring tools. It lists and describes applications of six interchangeable types of Davis blocks, including the recently announced throw-away carbide-insert type. **516**

TAPS AND GAGES—DoALL Co., Des Plaines, Ill. Tap and gage selector chart containing at-a-glance information formerly obtainable only from two or three different references. It lists the DoALL tap, tap-drill size, and plug and ring gages needed to produce and check classes of thread. **517**

LIMIT SWITCHES—National Acme Co., Cleveland, Ohio. Bulletin EM-5912, describing a complete line of heavy-duty water and oiltight Snap-Lock limit switches. Designated Series D-1200X-D200X, these switches can be obtained in standard, neutral-position, short-travel, and push-lever models. **518**

NUTS—McLaughlin Co., Birmingham, Mich. Catalogue No. 112-M-14, covering a complete line of various clinch, pilot, and weld nuts in standard and special types. Featured is a patented quick-attachment expansion nut suitable for use in either manual or automated fastening applications. **519**

TAPS—Besly-Welles Corporation, South Beloit, Ill. Catalogue containing a wide variety of information helpful to tap users. Tap-size selection data, complete information on class of fit, limit numbers, gage data, and availability from stock are combined into one table. **520**

GUN-DRILLING—Cleveland Twist Drill Co., Cleveland, Ohio. Manual containing information on all phases of gun-drilling, including explanations on how gun drills can be used on critical drilling jobs involving fine finish, accurate size, pinpoint location, and holes of all depths. **521**

STAINLESS STEEL WIRE — Uddeholm Co. of America, New York City. 77-page book on cold drawn stainless-steel wire. It describes the general qualities of twenty-seven different types of ferritic, austenitic, ferritic-austenitic, and martensitic stainless steels available. ..**522**

BAND SAWS—W. F. Wells & Sons, Three Rivers, Mich. Cover folder with eight separate insert sheets describing nine different ways to profit with the firm's hori-

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zontal metal-cutting band saws. It gives a thumbnail summary of every standard-model saw in the line. **523**

INDUSTRIAL FLOOR CLEANING—Oakite Products, Inc., New York City. Booklet F10593, entitled "Industrial Floors: How to Clean and Care for Them," discussing cleaning of industrial floors of every kind—in factories, diesel power plants, and aircraft hangars. **524**

METAL FORMING — Floturn Division, Lodge & Shipley Co., Cincinnati, Ohio. Bulletin DM-5, describing "Flo-Reforming," a new process for producing tall, shell type, cylindrical parts. Included are cost comparisons with deep-drawing, engineering information, and equipment details. **525**

CLAMPING SYSTEMS—Hi-Lo Products Co., Detroit, Mich. Brochure No. 858 illustrating all the components of the Hi-Lo clamp starter set, and showing how adjustable Hi-Lo clamps are used to secure work-pieces on bolster plates and machine tool tables. **526**

LIMIT SWITCH—R. B. Denison Mfg. Co., Cleveland, Ohio. Bulletin M-1, presenting full descriptive details and engineering data on the company's Loxswitch Model M precision limit switch which surpasses 55,000 cycles under electrical load. **527**

GEAR AND FLUID DRIVES—Link-Belt Co., Chicago, Ill. 48-page Book 2747, "Gearmotors, Motogears and Fluid Drives," describing the functions of these various types of drives and providing detailed selection data, dimensions, overhung load ratings, and mountings. . . **528**

CAM INDEX DRIVES—Expert Welding Machine Co., Detroit, Mich. Engineering data sheet (No. 157), describing a line of standard cam index drives that provide accurate, smooth, rapid, and shock-free indexing of heavy-duty work-tables on dial and trunnion type machine tools. Drawings are included. **529**

CENTRALIZED LUBRICATION—Lincoln Engineering Co., Industrial Division, St. Louis, Mo. Brochure discussing application of modern centralized lubrication to reduce industrial operating costs and improve production, entitled "A Report to Management." **530**

MATERIAL-HANDLING MACHINES — Gorske Industrial Equipment, Indianapolis, Ind. Bulletin featuring Gorske service vehicles—self-propelled scavengers and coolant servicers. These material-handling and plant-maintenance machines are designed to cut machine tool down time. **531**

DRIVE EQUIPMENT—General Electric Co., Schenectady, N. Y. Bulletin GEA-6909, a unique and complete kit featuring drive-selection information to help determine the drive that most completely and economically meets the reader's requirements. **532**

PLATE AND FACE CAMS—Ferguson Machine Corporation, St. Louis, Mo. Catalogue No. 900, introducing standard and semi-standard plate and face cams. Nearly one hundred standard units are listed by stroke, timing, and load rating. **533**

JIGS AND FIXTURES — Northwestern Tools, Inc., Dayton, Ohio. Catalogue covering over 500 components for jigs and fixtures, and over 250 clamping items. Full-scale tracing templates of the jig and fixture components are included. **534**

STAINLESS TUBING—Babcock & Wilcox Co., Beaver Falls, Pa. Technical data card TDC-192, describing the high-temperature properties of B & W Croloy 25-12 (309), its chemical composition, size ranges, and short-time tensile and rupture properties. **535**

POWER TRANSMISSION—Dodge Mfg. Corporation, Mishawaka, Ind. Bulletin A-706, reviewing the company's line of power-transmission machinery. It features Flexidyne dry fluid drives and Para-flex flexible cushion couplings, plus related equipment. **536**

LEAD SCREWS AND WAYS—Famco Machine Co., Kenosha, Wis. Bulletin entitled "Famco Mills with Hard Chrome Plated Ways," describing Famco's way curtains and optical vernier. **537**

AIR CHUCKING—Cushman Chuck Co., Hartford, Conn. Bulletin PO-66D, presenting cost and time-saving advantages of air-operated chucking systems. . . **538**

SAFETY SIGNS—W. H. Brady Co., Milwaukee, Wis. Catalogue describing over 400 self-sticking accident-prevention signs. Testing samples are available. **539**

PUNCH PRESS—Kenco Mfg. Co., Los Angeles, Calif. Catalogue describing an Electro-Safe punch press series. **540**

CLAMPS—Insta-Clamp Co., Dearborn, Mich. Circular describing the company's hold-down clamps for use in tool-rooms, welding shops, etc. **541**

JIG GRINDER—Carl Hirschmann Co., Inc., Manhasset, N. Y. Catalogue de-

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scribing the Hauser 3SM precision jig grinding machine. 542

SLIND RIVETS—Huck Mfg. Co., Detroit, Mich. Folder (Form 8-457), describing Huck MS aluminum self-plugging blind rivets. Outstanding features and typical applications with cross-section line drawings are shown. 543

BERYLLIUM MACHINING—Alsco Beryllium Machining Corporation, Valley Stream, N. Y. Brochure describing an unusual facility, the first on the East Coast to be designed especially for ultra-precision machining of beryllium with complete safety. 544

PRESS — Punch Products Corporation, Niagara Falls, N. Y. Catalogue 1012-1, describing the air-hydraulic, 10-ton Unipunch press complete with precision Unipunch gaging and tooling for punching holes in angles, channels, extrusions, and sheets. 545

MEASURING INSTRUMENTS — Petz-Emery, Inc., Pleasant Valley, N. Y. Bulletin E, describing "Pet-line" gages and measuring instruments, including Model A comparator, Model B comparator, depth gages, weighted indicators, and a "jumbo" magnetic-base indicator support. 546

DIAMOND WHEELS—The Carborundum Co., Niagara Falls, N. Y. Folder entitled "Carbide Grinding with Man-Made Diamond Wheels," presenting a practical condensation of facts and recommendations on man-made diamond wheels, with illustrations. 547

PUNCHES AND DIES—Porter Precision Products, Cincinnati, Ohio. Catalogue No. 200, illustrating the standard line of punches and die buttons, "Bal-Lok" punches and dies, and similar units. **548**

MACHINING ALUMINUM — Reynolds Metals Co., Richmond, Va. Technical handbook entitled "Automatic Screw Machining of Aluminum," containing data on all phases of the light metal's use in this demanding operation. ..**549**

ROLLER BEARINGS—Rollway Bearing Co., Syracuse, N. Y. Catalogue PL-559, giving useful information on the features, applications, and availability of the company's nine principal lines of roller bearings. **550**

HAND FORGINGS—Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif. Booklet listing complete availabilities, properties, and engineering information for the company's aluminum hand forgings. **551**

STUDS AND NUTS—Republic Steel Corporation, Cleveland, Ohio. Folder (Adv. 1019-R), describing the company's alloy-steel studs and high-carbon steel, hexagonal nuts, and outlining their advantages. **552**

MAGNETIC TOOLS—Cullen Mfg. Co., Racine, Wis. Catalogue 958, describing Erich Magna-Holders, the company's magnetized holding devices, and a wide variety of individual magnets for use in experimental and day-to-day operations. **553**

MARKING DEVICES—New Method Steel Stamps, Inc., Detroit, Mich. Catalogue MA-59, describing automatic roll marker and manual marking devices for most product-marking and identifying requirements. **554**

SEALING PROCESS—National Sinter-Seal Co., Buffalo, N. Y. Booklet describing Sinter-Seal, a process developed to solve the problem of porosity in powdered-metal parts. **555**

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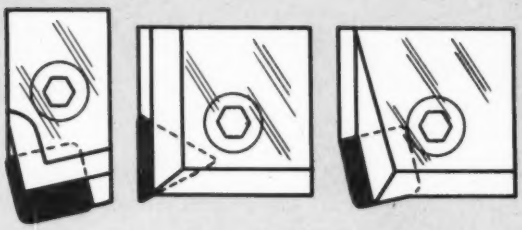


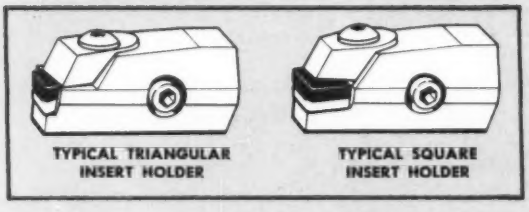
TYPICAL STANDARD WESSON COMPONENTS

carbide TOOL NEWS

BUILDING BLOCK TOOLING

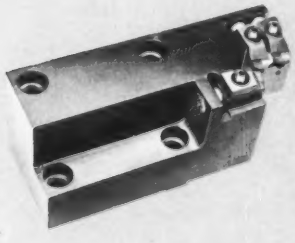
- ***Easier to design for special applications***
- ***Maintained with smaller inventories of parts***
- ***Greater accuracy in production***

MULTIPLE-POINT micro-adjustable and key-type boring quill combines standard insert holders of several types and a standard anvil-clamp unit. To hold these standard components in correct positions, a simple special body has been designed around their required locations.



TYPICAL TRIANGULAR INSERT HOLDER

TYPICAL SQUARE INSERT HOLDER



TOOL BLOCKS can be designed with the same standardized components that are used to bore and chamfer. This tool is used to rough turn and face transmission parts. Standard micro-adjustment units permit rapid setup, and each square insert has eight cutting edges.

Any time the word 'special' is mentioned to a production engineer, he unconsciously winces. He wants the added production or the better quality that can come with specials but he does not want to have to justify the extra first cost to his boss.

All tools start out as specials but when a market is built up for a particular design, it is standardized. Now, carbide-tool producers are leading the way to greater standardization and to more widespread use of carbides.

Standard components first became normal practice with the introduction of band-type and throw-away insert type holders. The carbide slugs and inserts, and the holders had to have standard dimensions. This was so obvious that nobody recognized what it meant—either to users or producers.

It is difficult to maintain brazed-in cutting points that have to be accurately ground in relation to the tool body and to each other. However, multiple-point throw-away tooling has been used sparingly because it is the most complex of the special tools. But all production engineers recognize the tremendous advantages that are possible when several operations are combined in one tool.

Gradually, carbide throw-aways and slugs have been applied to special multiple-point tools, and the problems of grinding and setting disappeared. It is only necessary to grind off the slug and adjust it or index the insert, and the tool is ready for re-use.

Wesson recognized that most of the special multiple-point tools they were designing were made from just a few types of components. With this recognition, came an intensive investigation to determine how few different components would cover the majority of special-tool needs.

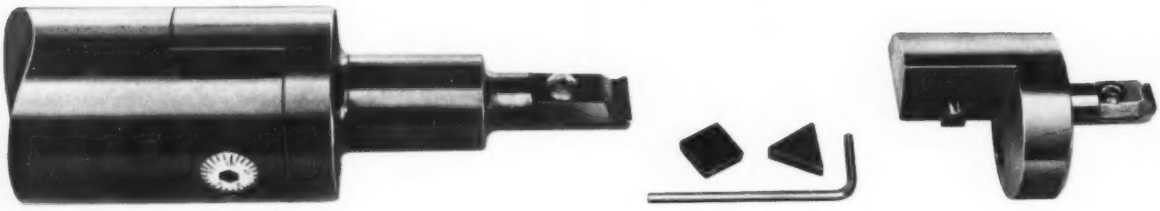
Wesson now has about 20 standardized insert holders (see inset at left) for triangular and square inserts of different sizes, and with positive and negative rakes, few of which are needed in any one tool. They have 4 standardized anvil-clamp units (see examples at top of page) for square and triangular inserts. Standardized micro-adjustable units can be applied to most bars or heads to allow for axial or radial adjustments.

(continued on next page)

Wesson Announces

NEW INTERCHANGEABLE HEAD BORING BAR

- **Head is micro-adjustable**
- **Boring bar covers range from ½″ to 1½″ ID**



BORING BAR AND ⅝″ HEAD

½″ HEAD

Carrying on the 'building-block' idea one step further, Wesson now has designed a micro-adjustable boring bar that can carry interchangeable heads for boring holes from ½ to 1½ inches in diameter. When in the bar, the head can be adjusted ¼ inch on the diameter.

This is the first time that small-hole boring has been possible with a standard throw-away insert tool that can also be used for larger holes. These tools can be maintained easily at the machine because they use standard triangular and square carbide inserts.

Building Block Tooling

(continued from previous page)

Now, the design of a special multiple-point tool is a simple matter. The work-piece and its tolerances set the requirements for the types of inserts, holders, clamps, anvils and adjustments needed. Relationships among the surfaces to be machined indicate the length and breadth of the tool.

It is then only necessary to draw the standard components in space and fill in the special body required to hold the components where they belong. A check of this body is made to be sure of its strength through all sections and then the tool can be made.

Special tools will still be made by carbide-tool producers—this will not lead to do-it-yourself tooling—but the user benefits through lower costs, shorter lead times, smaller inventories of spare parts and the chance to specify special tools wherever they should be used.

tools Wesson carbide Wessonmetal

WESSON COMPANY, DEPT. AD
1220 Woodward Heights Blvd., Detroit 20, Mich.

IN CANADA:
WESSON CUTTING TOOLS, LTD.
93 Judge Road, Toronto 18, Ontario

Conventional Carbide Tools Best Bet For Most Jobs

1. *Band type with carbide slugs*

Band-type Wesson Multicut holders are available in 9 specific types with 90 standard sizes available from stock. Holders are designed for square, triangular or diamond (with various lead angles) carbide slugs to turn, face and cut tapers. They are precision made with tempered steel bands, hardened shank and broached holes. Carbide slug can be locked from top or bottom of the holder and many tools can be packed in small areas for multiple operation. Standard Wessonmetal slugs always available from stock and replacement bands that fit can be quickly supplied.

CUTS RIGHT TO LEFT
(LEFT-HAND ALSO AVAILABLE)

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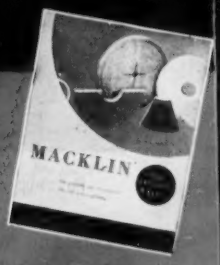
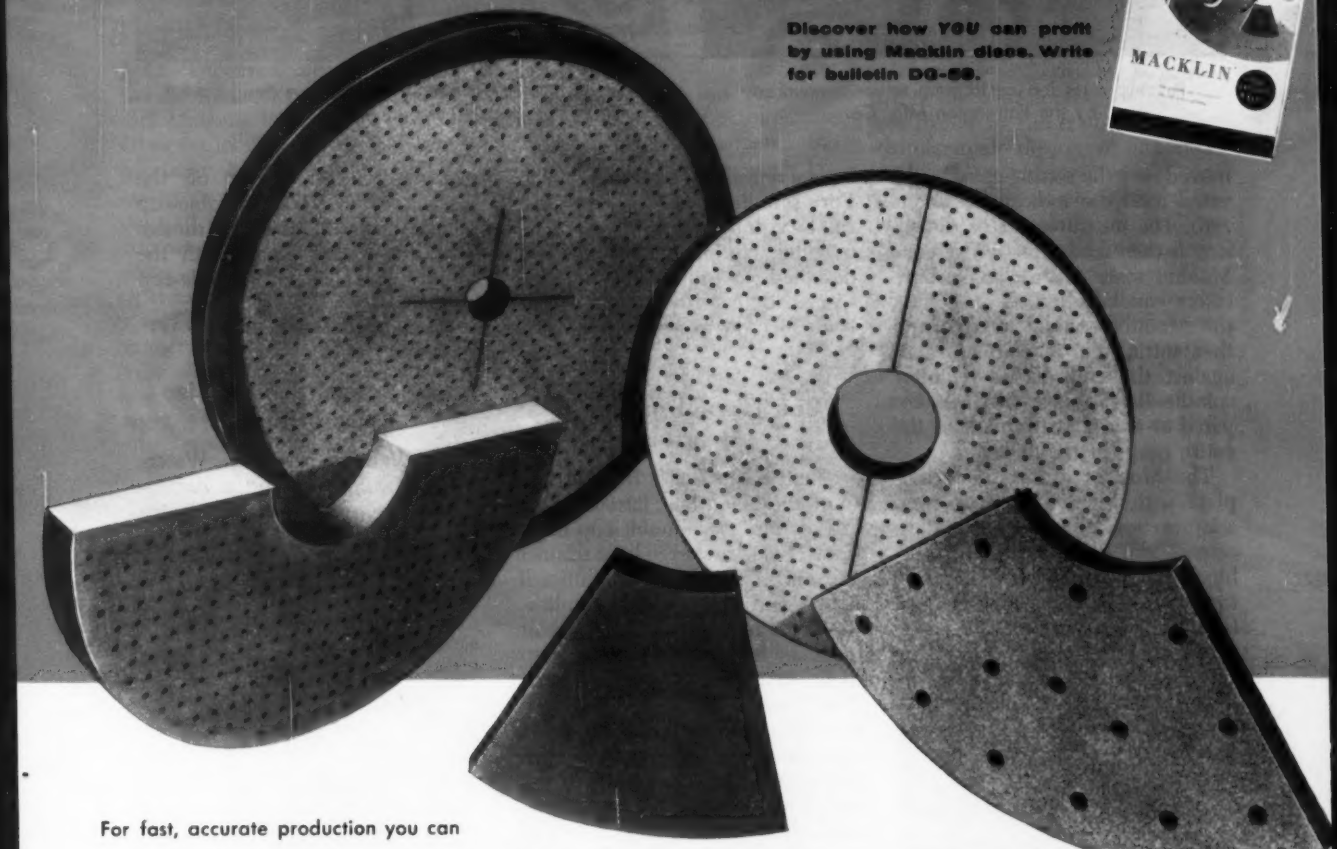
whatever your disc grinding job.....

MACKLIN

has a money saving answer!



Discover how YOU can profit by using Macklin discs. Write for bulletin DG-58.



For fast, accurate production you can depend on Macklin abrasive discs. Nut-inserted, bolt inserted, or plate mounted, each is custom built to your exact job requirements for standard disc grinding or vertical surface grinding.

Exactly matched, and uniform throughout, Macklin discs require less dressing, give greater stock removal and longer wheel life. See *for yourself* how Macklin discs cut free and clean; mount secure and flat. Consult your Macklin Sales Engineer or your nearest Macklin distributor. You'll find it's a money saving move!

Macklin discs are available in a complete range of sizes, types, and multiple gradings.

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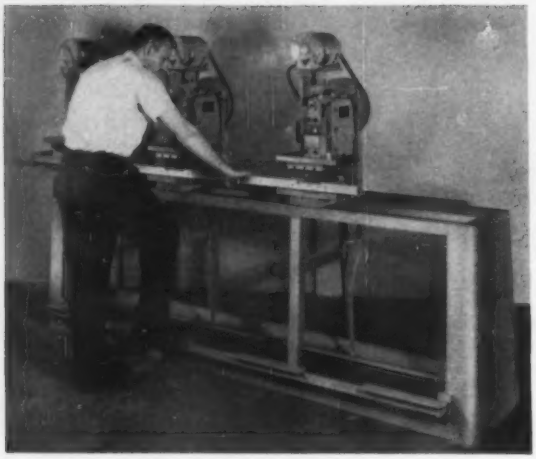
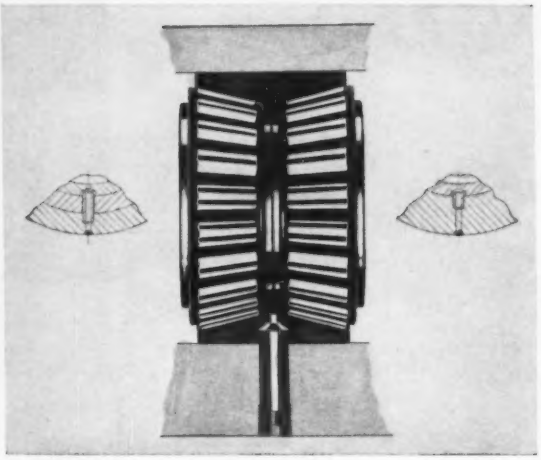
CYLINDRICAL GRINDING WHEELS • CENTERLESS GRINDING WHEELS • TOOL ROOM WHEELS • WIREBOUND CYLINDER WHEELS • FOUNDRY WHEELS • SEGMENTED WHEELS • CUT-OFF WHEELS



Punch presses for use in gang setups announced by the Fallsington Mfg. Co.



Timken "Pin" type double-cup bearing designed to prevent outer race from turning

moved and the setting spindle elevated until the indicator registers zero. The measurement or dimension is then read directly from the Monitor scale and dial. Dial indicators can be checked by setting the Monitor spindle to zero and then setting the indicator to zero against the end of the Monitor spindle. Readings can then be compared at any point throughout the entire range of the indicator.

The Monitor is furnished complete with wooden carrying case, adapter for checking test indicators, and an 0.500-inch gage-block. The gage-block is accurate to plus or minus 0.000005 inch and is used as a periodic reference check for the Monitor, as well as for setting the instrument to dimensions from 1.000 to 1.500 inch.

Circle Item 593 on postcard, page 199

Fallsington Punch Presses

The development of punch presses adapted for multiple-tooling or gang setups has been announced by the Fallsington Mfg. Co., Fallsington, Pa. These presses can be quickly set up so that multiple-station jobs requiring piercing, blanking, and forming can be done in one operation. Quick positioning is accomplished by means of a rack and pinion on a steel table. The presses can also be used singly. They are of all-welded steel construction and are available in 3- and 5-ton capacities. All presses have a repeat or non-repeat clutch. For simultaneous tripping they can be equipped with air-operated tripping equipment. Tables are designed to suit the customer's specifications.

Circle Item 594 on postcard, page 199

"Pin" Type Double-Cup Bearing

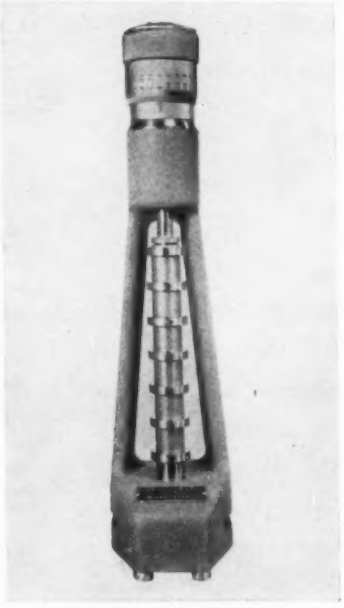
The Timken Roller Bearing Co., Canton, Ohio, has introduced a line of "Pin" type double-cup bearings. These are said to have distinct advantages over the conventional double-cup bearing on applications where there is an inherent tendency for the outer race or cup to creep or turn in the housing. They have been developed primarily for applications where bearings are used with loose cup fits, unclamped in floating positions, and where experience has indicated that a cup-locking device is desirable. Tests on rolling-mill drives, for example, have proved the effectiveness of this design.

A hollow pin located in the housing fits into the large countersunk hole in the outside of the cup. While the pin prevents the cup from turning in the housing, it does not restrict axial float, normally required as a result of shaft or housing expansion. This design facilitates the highly desirable feature of insuring positive bearing lubrication by introducing the lubricant through the hollow pin directly to the center of the bearing. "Pin" type double-cup bearings are designed to be dimensionally interchangeable with the conventional Timken double-cup bearings.

Circle Item 595 on postcard, page 199

Van Keuren Height-Size Gage Units

The Van Keuren Co., Watertown, Mass., is adding a dimensional gage, called the "HYT" size



Height-size gage introduced by the Van Keuren Co.

gage, to its line of precision measuring tools. This gage can be set to exact dimensions with an accuracy of 0.000050 inch. It thus eliminates the need for time-consuming assembling of gage-blocks. Through the use of a transfer gage it is possible, in a matter of seconds, to be ready to inspect drill jigs, lathe fixtures, gears, cams, splines, profiles, and contours in addition to checking many shop operations. It is especially adapted for the setting of precision depth gages on drill presses, milling machines, jig borers, etc.

A patented, spring-loaded, nonrotating spindle eliminates all chance of backlash, and measuring surfaces are accessible from front and back. Slots are provided in the base to permit clamping to an angle-plate so that the gage can be used in a horizontal position. The HYT size gage comes in a 10-inch model with 3- and 6-inch riser blocks and 18-inch transfer gage.

Circle Item 596 on postcard, page 199

Fosdick Numerical Control with Improved Memory System

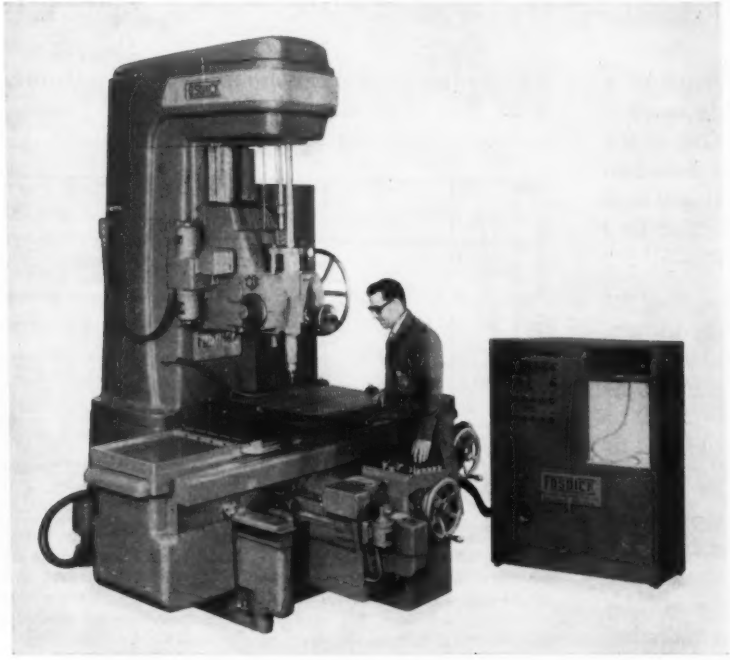
An improved memory system has been developed by the Fosdick Machine Tool Co., Cincinnati, Ohio, for its numerically controlled precision boring machines. This system employs an electromechanical unit that works with the tape-control reader to anticipate machine actions and speed up their operations. It is designed to supply a memory system needed by many numerically controlled machines to take care of the time lag between reading of the tape and the moment when the machine can perform the action called for. The system selected for this work was found in a component of automatic telephone systems, namely, the cross-bar switch. As its name implies, the most striking feature of this switch is the grating of crossed bars, actuated by electromagnets. The bars in the X-axis feed information into the switch. The bars in the Y-axis pick up the information and hold it for release when needed. Each cross-bar switch contains ten columns of ten contacts. In effect the switch has 100 "pockets"—ten representing the numeral "1," ten representing "2," etc. —in which digital information can be stored.

Each switch measures 23 by 9 by 6 inches. It takes only two cross-bar switches to store all the information needed to control spindle feeds and speeds, and two axes of table movement. A third can handle spindle depth control and tool designations; and a fourth, automatic tool changing. Five such switches are easily housed in the standard control and tape-reader console furnished with Fosdick numerically controlled jig borers. No additional cabinets are necessary.

The relays and cross-bar switches are of the plug-in type, and spares are stored in the control console. No electronic devices of any kind are used, so that maintenance can be handled by an electrician. The addition of numerical control to Fosdick jig borers and jig grinders, Models 44 and 45, brings these precision machines out of the strictly toolroom class and places them in the class of machine tools used in automated production lines.

Circle Item 597 on postcard, page 199

(This section continued on page 210)



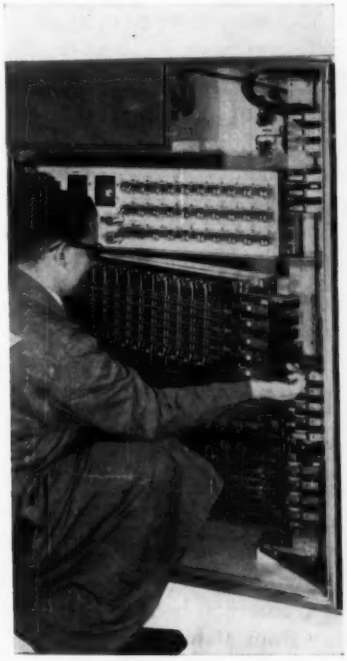
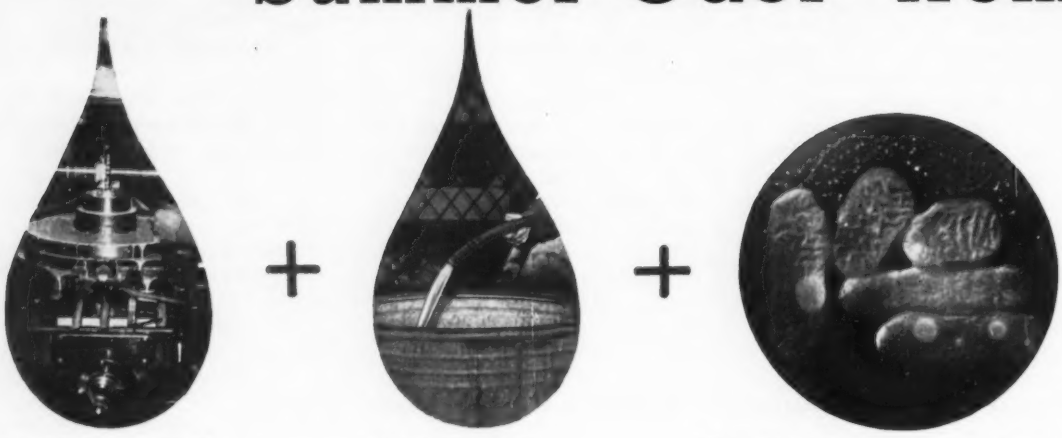


Fig. 1. (Left) Tape-controlled Fosdick precision boring machine set up for quantity-production job requiring the accurate location and boring of many holes. Fig. 2. (Right) Tape control console for Fosdick precision boring machine that houses cross-bar switches which act as an electromechanical memory system.

"Summer Odor" from



SOLUBLE OIL + WATER + PSEUDOMONADS

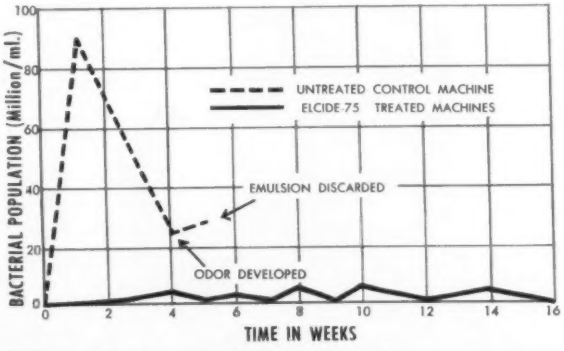
...can be controlled

Nearly everyone has experienced the "rotten egg" smell of spoiled soluble oil emulsions. Here's an explanation of what happens to cause it... and how you can control it with Elcide 75.

THE CAUSE: The oil-and-water mixture of a standard duty soluble oil emulsion produces ideal feeding conditions for certain bacteria. One of the most common types, *pseudomonads*, can be found in all emulsions. Once established, they multiply rapidly . . . especially in warm weather . . . and feed on the emulsion.

As these pseudomonad colonies build up, they set the stage for a secondary contamination by sulfate-reducing bacteria. These bacteria feed on the petroleum sulfonates commonly used as the emulsifying agent in soluble oils. As they multiply, they throw off H_2S, the hydrogen sulfide gas known in metalworking plants as "summer odor."

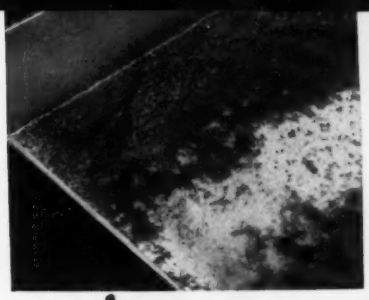
Unfortunately, the damage from bacterial contamination does not end here. As the odor develops, the bacteria continue feeding on the emulsifier until the emulsion breaks. This process changes the mixture from alkaline in composition to corrosive acid. Other by-products from the bacteria form a slime that clogs screens and filters, and presents certain hygienic hazards.



This record of an actual in-plant test shows how untreated emulsion allows rapid bacterial build-up. The downward curve of the untreated emulsion is where secondary contamination by the sulfate-reducing bacteria starts its final destruction. Note the comparison between this and the Elcide 75-treated emulsion which lasted 5½ times longer.

ELI *Lilly* AND COMPANY • AGRICULTURAL AND INDUSTRIAL PRODUCTS

rancid emulsions

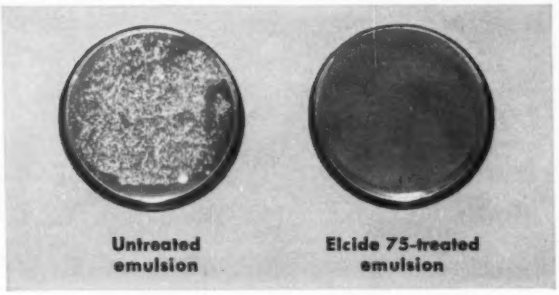


$+ \rightarrow H_2S\uparrow$

SULFATE-REDUCING BACTERIA

(SUMMER ODOR)

with ELCIDE 75



THE CURE: **ELCIDE 75 hits this problem at the very first stage** of bacterial growth. The petri dishes above show the contrast between an untreated emulsion and an emulsion treated with Elcide 75. The light areas in the untreated sample are bacterial colonies. Because Elcide 75 is a new, wide-spectrum bacterial inhibitor, it attacks and controls not only the more common bacteria, but also mutants which frequently develop. Just one ounce of Elcide 75 to each 4 gallons of fresh emulsion breaks the vicious cycle of bacterial growth before it starts . . . thereby greatly extending the useful life of your coolant.

ELCIDE 75 is a reliable way to prevent the waste of frequent emulsion changes. Its wide range of antibacterial action insures a constant control that not only prevents summer odor, but also reduces production costs. Many plants have thoroughly tested Elcide 75 in comparison to untreated emulsions. Their findings indicate Elcide 75-treated emulsions last far longer, reduce downtime and oil concentrate costs, and increase total productivity.

If you have not yet tried Elcide 75 in your plant, we urge you to try it now . . . before the heat of summer further inflates your personnel problems and operating expenses.

PRODUCT SPECIFICATIONS—ELCIDE 75

(Lilly's brand of bacterial inhibitor for cutting fluids)

Active Ingredients—Sodium Ethylmercuri Thiosalicylate (Thimerosal) and Sodium *o*-phenylphenate.

Package	Price per Gal.
1-gal. (4 per case) polyethylene .	$8.50
5-gallon polyethylene	$8.00
55-gallon stainless steel	$6.50

Sold only through selected distributors.

For more information or to place your order, write or phone:

ELCIDE 75™

PATENT PENDING

KEEPS COOLANTS FRESH AS A DAISY!

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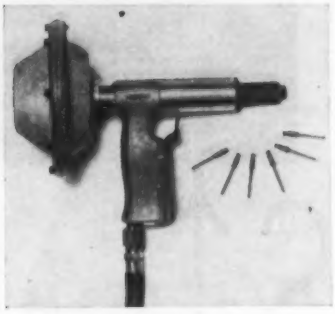


"Texan" pneumatic riveting gun

Lightweight Pneumatic Riveting Gun

A new type of riveting gun that weighs less than 4 pounds, designed to facilitate construction and assembly work in a wide range of industries, has been developed by the "Pop" Rivet Division of United Shoe Machinery Corporation, Boston, Mass. It can be used in home and commercial building; bus, truck, and trailer construction; boat building and repair; and the installation of air-conditioning and heating units. The gun is called the "Texan." It is easily portable and is capable of operating off the plant air line or by portable air compressors. Since peak efficiency is maintained even when the connecting air hose is as long as 60 or 70 feet, the gun extends assembly line production techniques to the construction of metal roofing, the installation of duct work, the erection of curtain walls or buildings with aluminum or steel-panel exteriors, and many other in-field and plant assembly jobs.

The pneumatic gun will operate on compressed air having a pressure as low as 60 psi or as high as 90 psi. The stroke is 5/8 inch and the pulling force nearly 1000 pounds. The gun is designed to pull nearly all sizes and types of "Pop" rivets including the recently introduced closed-end Imex rivet. Its extremely fast-acting cycle sets the rivet when the trigger is pulled. Minimum maintenance costs, adaptability to rivets with shank diameters up to 1/8 inch in steel or aluminum, and extremely easy handling are other advantages claimed for this tool.

Circle Item 598 on postcard, page 199

Broach with Removable-Shell Finishing Section

A Red Ring process developed for the economical production of precision internal spur and helical gears and splines has been introduced by National Broach & Machine Co., Detroit, Mich. Called "Full-Form Finish" broaching, it makes use of a combination roughing broach and a removable-shell type finishing section, shown in Fig. 1, that enables smooth, precision gears or splines to be produced in a blank at a single broaching operation. The shell type finishing section is shown removed from the pilot on the end of the roughing broach and rests beside the broach.

This broaching process is being initially applied to the production of large, internal involute SAE 5140 and 4047 steel running gears for automotive transmissions that formerly required both a roughing

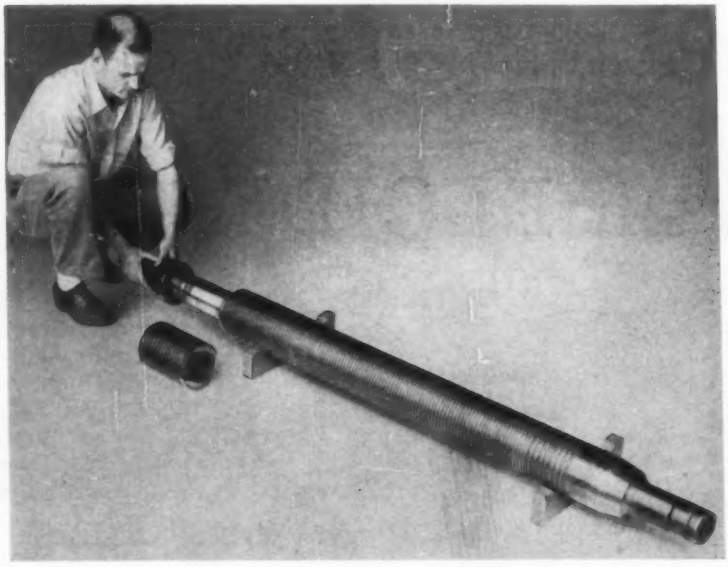


Fig. 1. Typical Red Ring "Full-Form Finishing" broach for producing a large internal helical running gear

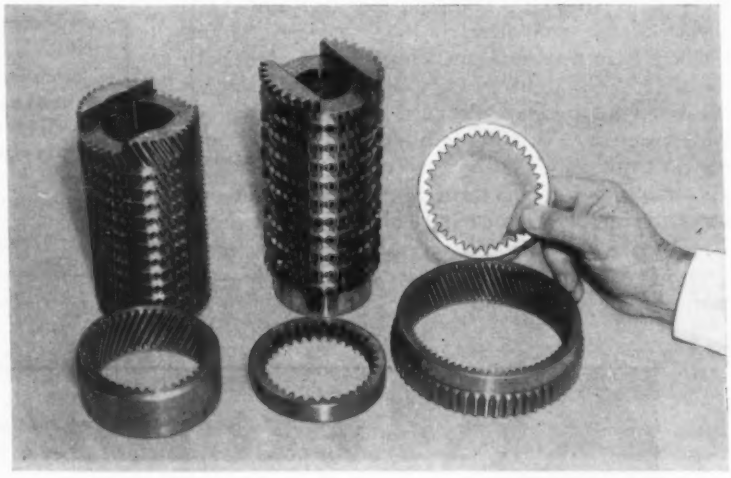


Fig. 2. Typical Red Ring "Full-Form Finishing" broach shells shown with a variety of internal spur and helical running gears that have been produced by the new broaching process

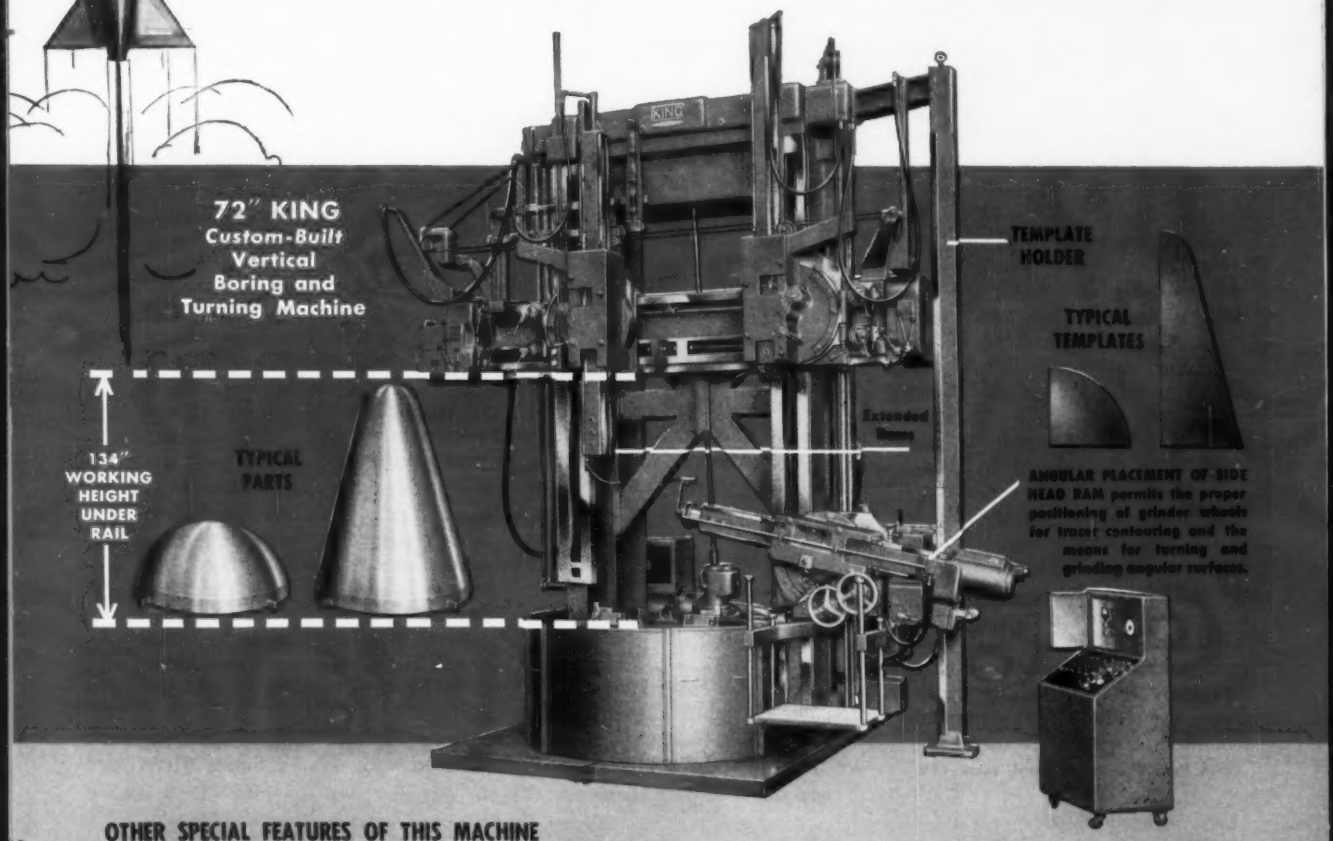
Another KING "Defense Production Special"

"Tailor-Made" to Specific MISSILE Requirements ... Yet Retaining All General-Duty Features

Recently installed in one of the nation's leading aircraft plants, this specially-built unit is a good example of the wide range of design versatility which is available in KING® Vertical Boring and Turning Machines.

When you buy a custom-designed KING machine, you buy only the accessory equipment, electrical controls, and design modification which your special-work machining operation requires—*no more and no less!* And always, you have in the basic machine all the standard facilities for general-purpose boring, facing, and turning.

This KING combination of special features and general-purpose facilities makes *all the difference* in competitive cost-control.


72" KING
Custom-Built
Vertical
Boring and
Turning Machine
TEMPLATE HOLDER
TYPICAL TEMPLATES
134" WORKING HEIGHT UNDER RAIL
TYPICAL PARTS
ANGULAR PLACEMENT OF SIDE HEAD RAM permits the proper positioning of grinder wheels for tracer contouring and the means for turning and grinding angular surfaces.

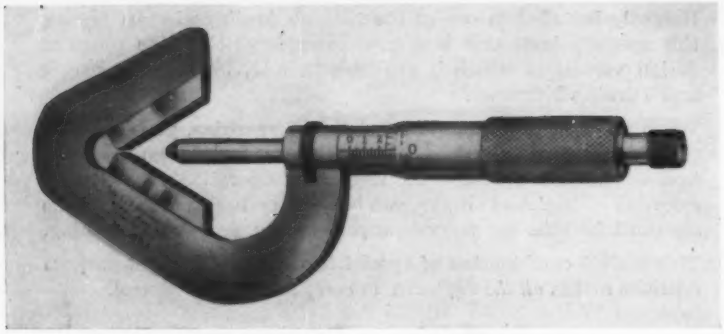
OTHER SPECIAL FEATURES OF THIS MACHINE

- √ **Swiveling type side head** arranged for tracer controlled turning and grinding operations.
- √ **Grinding attachment** with multi-speed precision motorized spindle extending through side head ram and arranged to receive interchangeable quills. Attachment includes balancing type wheel holders and wheel guard with exhaust outlet.
- √ **3-position tool holder for side head,** which can be readily interchanged with grinder quills for turning operations.
- √ **Operator carrier platform attached to side head,**
- √ **Console control system.**
- √ **Electronic, two-dimensional (360°) tracer mounted on side head.** Template holder arranged to support templates of the type required for work pieces utilizing full capacity of the machine. Universal adjustment is provided for the tracer head.
- √ **Electronic, two-dimensional (360°) tracer mounted on rail head.** Template holder mounted on top of rail to provide maximum work clearance above table. Positioning controls for stylus head for operator convenience.
- √ **Constant surface cutting speed attachment and constant chip thickness controls** applied to both tracer heads.
- √ **Coolant** conducted through rail head rams.

For further details on KING machines—standard 30" to 144" designs or special custom-built units—see your authorized KING Distributor, or write to us direct.

AMERICAN STEEL FOUNDRIES, KING MACHINE TOOL DIVISION
1150 TENNESSEE AVENUE, CINCINNATI 29, OHIO

KING Vertical Boring and Turning Machines



V-anvil micrometer developed by the L. S. Starrett Co.

and a finish-broaching operation to produce parts of sufficient accuracy and finish.

The Red Ring broach designed for the application of "Full-Form Finish" broaching has a long roughing section of conventional design that produces the internal spline or gear teeth to rough size. Mounted on a pilot on the end of the broach is a short shell broach, Fig. 2, that performs the tooth-finishing operation. The term "Full-Form Finishing" applies to the method by which the finishing shell produces smooth tooth surfaces.

Significant cost savings are claimed in the precision production of both spur and helical internal gears in the 10- to 20-pitch range with pitch diameters from 3.100 to 5.783 inches and 0-degree to 27-degree helix angles. Secondary finish-broaching operations are completely eliminated when the new broach is used.

Circle Item 599 on postcard, page 199

Micrometer for Detecting Grinding Errors

An improperly adjusted centerless grinder can produce work that is deceptively out-of-round. Conventional two-point measuring tools which check only the diameter will pass such work. The No. 483 V-anvil micrometer illustrated was developed by the L. S. Starrett Co., Athol, Mass., to overcome this difficulty. This instrument has three-point contact which quickly detects out-of-round work, thus alerting the operator to the need for machine adjustment.

The No. 483 is also designed for measuring three-fluted cutting tools—taps, milling cutters, reamers, etc. A companion micrometer, No. 485, measures five-fluted cutters.

The V-anvil micrometers are used like conventional outside micrometers with the cutter held in one hand and the contact face of the measuring spindle placed against one cutting edge. The cutting edge must be lined up with the spindle axis. The reading is taken directly in thousandths of an inch from the micrometer thimble.

Precision features include a spindle that is precision-aligned to form perfect tangential contact; finely lapped carbide facings to eliminate wear from continuous use under abrasive conditions; hardened and ground-from-the-solid spindle screw; no-glare satin chromium finish for easy reading in any light; and balanced design for easy, one-hand measuring.

Circle Item 600 on postcard, page 199

Waldes Kohinoor Truarc "Ring-Gun" and "Ring-Jector"

Two retaining-ring assembly tools which combine applicators and magazine-fed ring dispensers in one unit have been developed by Waldes Kohinoor, Inc., Long Island City, N. Y. Known as the Truarc "Ring-Gun," Fig. 1, and "Ring-Jector," Fig. 2, the tools are designed for use in the automotive, electronics, electrical appliance and equipment industries, and other fields where high-speed, assembly-line ring installation is required. They are particularly suitable also for ring applications in which the work-piece is too large to be brought to a fixed assembly station.

Ring-Gun and Ring-Jector may be used with Truarc Series 5103

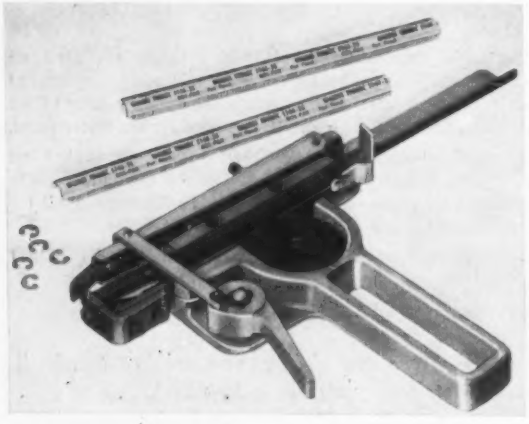
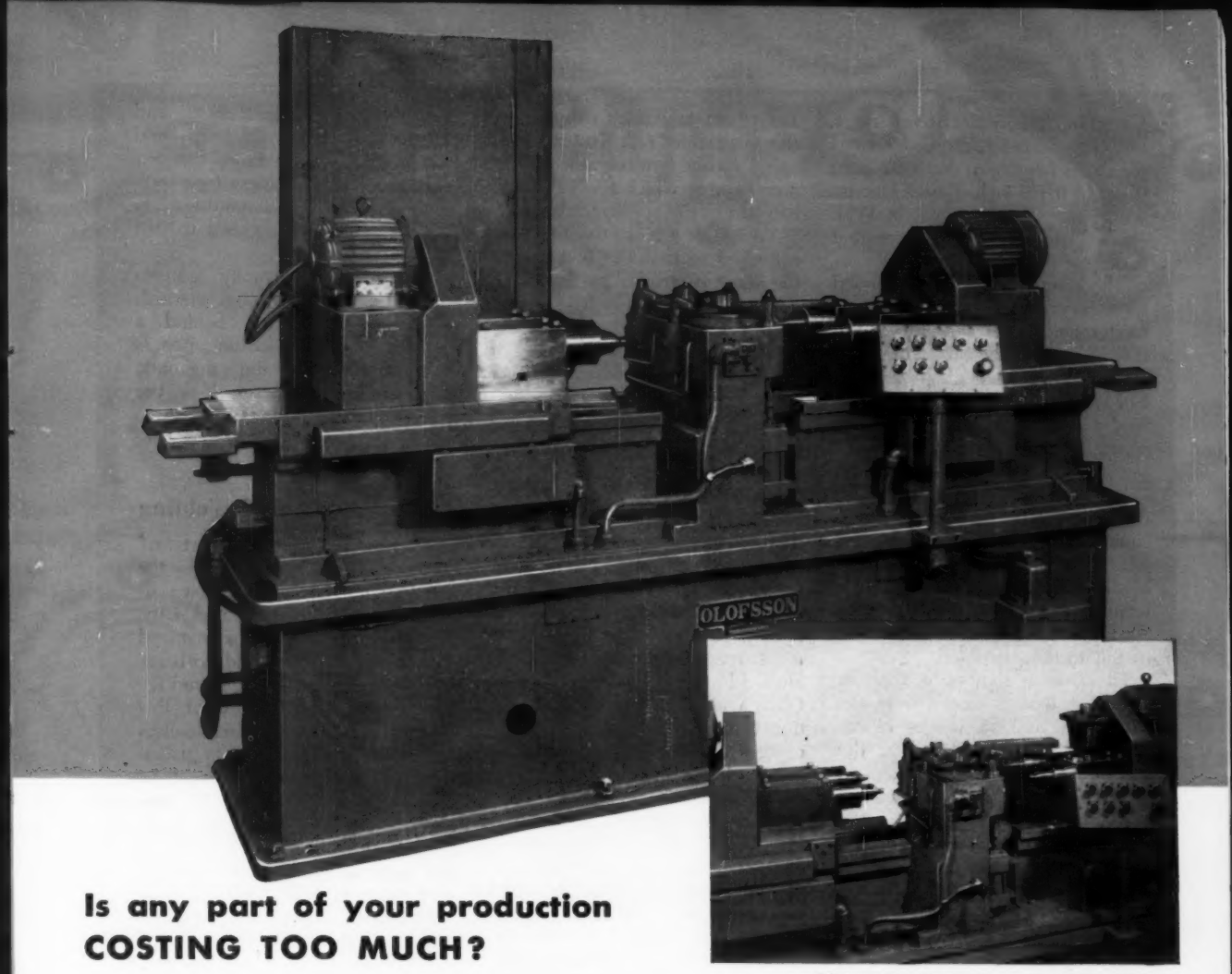


Fig. 1. Truarc "Ring-Gun" assembly tool manufactured by Waldes Kohinoor, Inc.

Fig. 2. Waldes Kohinoor Truarc "Ring-Jector" used to install rings on hinge pins



Is any part of your production COSTING TOO MUCH?

Olofsson Two Station Precision Boring Machine arranged with Way Units. Conforms to J.I.C. electrical and hydraulic standards.

Today's competitive market demands constantly increasing production per man hour. Any machine tool which can't deliver that kind of production is too costly to operate. That's why an automotive manufacturer recently consulted with Olofsson engineers to increase production and lower unit costs on a boring operation. The result...

TYPE OF MACHINE—Olofsson Two Station Double End Precision Boring Machine arranged with Way Units.

WORK PERFORMED—Finish bore two holes, *in line,* simultaneously in cast iron differential cases.

RATE OF PRODUCTION—250 cases per hour.

MACHINE OPERATION—The operator loads the part into the nest and presses the clamp and start cycle button. Both units bore "in" simultaneously and rapid return to unload position. Hydraulically operated finger clamps release the part automatically when both units are in clear position. A manually operated elevator device is used to help insert and unload part from nest with ease.

Hand cycle provides additional retraction of spindles for setting or removal of cutting tools, also independent control of either unit.

Perhaps you have a tough production problem which can be solved efficiently and economically with Olofsson Special Machinery. You'll find it "pays to specialize with Olofsson".

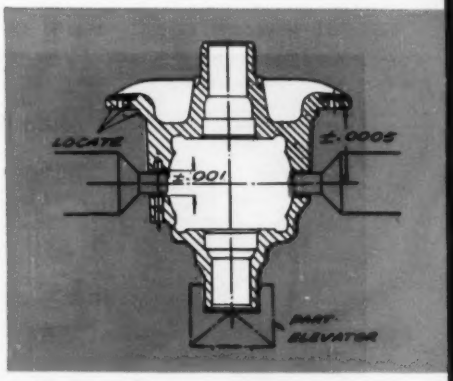


Diagram of differential case clamped into position for simultaneous, double-end precision boring operation.

Put the Olofsson Engineering Department to work for you. Write today. Or phone us at IVanhoe 4-5381, Lansing, Michigan.

THE OLOFSSON CORPORATION

2729 Lyons Avenue • Lansing, Michigan

Manufacturers of Special and Automation Machinery and Precision Boring Machines

Crescent rings, Series 5133 E-rings, and Series 5144 reinforced E-rings for shafts ranging in diameter from 0.125 to 0.375 inch. Rapid loading with the firm's new Rol-Pak stacked rings assures a constant supply of the fasteners.

The Ring-Gun, Fig. 1, is loaded with rings simply by removing a feeder guide and slipping a Rol-Pak of stacked rings over the back of the magazine rail. When the Rol-Pak tape is removed and the feeder guide replaced, a spiral spring attached to the feeder pushes the rings forward to a recess in the applicator blade at the front of the tool. The trigger is connected to an actuating lever located opposite the applicator blade. The lever has a tongue which corresponds in thickness to the width of the groove in which a ring is to be assembled.

To install a ring on a shaft or stud, the tool is placed over the work-piece and the tongue of the actuating lever inserted into the groove. When the trigger is compressed, the lever pushes the shaft down so that the first ring in the stack enters the groove. Because there is a compression ratio of approximately 8 to 1 between the trigger and the actuating lever, installing the ring is a virtually effortless operation.

The Ring-Jector, Fig. 2, resembles a hand stapler in appearance. It is loaded with rings in much the same manner as the Ring-Gun; a feeder guide is removed and a Rol-Pak of stacked rings slipped over the magazine rail. Instead of a spiral spring, however, the tool has a coil spring which feeds the rings forward to the applicator blade.

To install a ring, the trigger is squeezed so that the first ring in the stack protrudes partially from the applicator blade. The ring is then inserted into the groove and the entire tool pushed forward to lock the ring on the shaft.

Circle Item 601 on postcard, page 199

Instrument that Air Gages and Records Dimensions

Data gathering for dimensional quality-control charts or for a charted record to serve as a size certificate can be accomplished rapidly and with machine accuracy by a gaging and recording instrument recently developed by the Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation. This instrument, using fixture type air-gage tooling, automatically records plus or minus deviation from nominal size on a 4-inch-wide strip chart. The standard model has a continuously driven chart and will inspect a single dimension. If desired, a model can be obtained for checking two dimensions. Optional features include maximum and minimum signal lights, and an index drive that moves the chart approximately 1/8 inch on each gaging operation.

Back-pressure type air gages used as the size-sensing elements include: open-jet, Balljet, and Bladejet spindles, air snaps and air rings, as well as Plunjet gaging cartridges. Existing flow type tooling up to 2000 to 1 amplification generally can be modified to suit the instrument.

The gage is virtually tamperproof, as all calibration controls and adjustments are behind a locked door. The scribing pen is cable-connected to the pneumatic servo motor that provides the power to position the pen.

Circle Item 602 on postcard, page 199

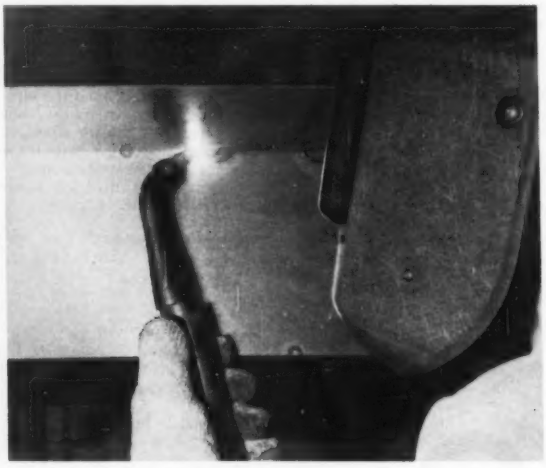
Linde "Short-Arc" Welding

A process called "Short-Arc" welding has been developed by the Linde Co., Division of Union Carbide Corporation, New York City. It permits manual and mechanized welding of thin material with excellent control of the weld puddle. The outstanding feature of this new inert-gas, consumable-electrode process is its ability to fusion-weld all common metals, such as carbon steel, stainless steel, aluminum (0.040-inch minimum thickness), copper, etc., in all positions and types of joints within a thickness range of 0.030 to 0.100 inch.

Successful operation of the process depended on the development of several factors. They are, proper power source, selection of shielding gas, and apparatus for feeding small-diameter wires. To avoid too much heat, which causes

(Continued on page 218)

Sheffield combination air gage and recorder

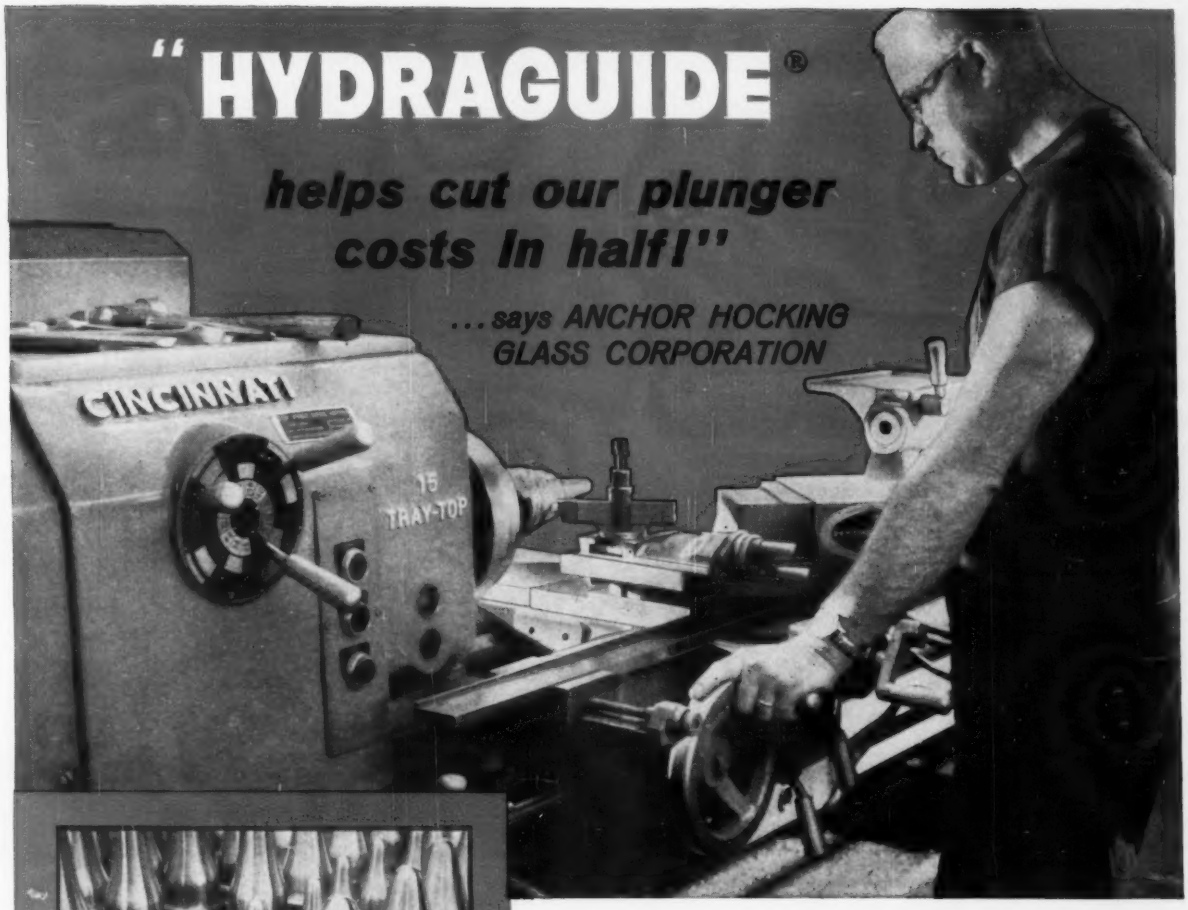


Overhead welding by Linde "Short-Arc" process

"HYDRAGUIDE®

helps cut our plunger costs in half!"

... says ANCHOR HOCKING GLASS CORPORATION



Various sizes of plungers from ¾" to 1⅜" tip diameters are machined with .001" tolerance from N-3 steel preforms on the 15" HYDRAGUIDE. Cincinnati HYDRAGUIDE Tracer Lathes are built in 15" and 18" swing sizes and a variety of bed lengths.

"We're now saving more than 50% of our former outside cost in producing glass machine plungers", says James Madden, Superintendent of Anchor Hocking Glass' Winchester (Ind.) plant.

Contributing greatly to this saving is the new 15" CINCINNATI HYDRAGUIDE which handles about 60% of the production. All operations of rough cutting, automatic profiling and polishing are performed on the lathe. In addition to the unvarying contours obtained, the smoothness of HYDRAGUIDE's hydraulic tracer mechanism is also credited with reducing the polishing operations required to produce the 25-30 Micro finish.

Ask your CL&T Dealer to discuss HYDRAGUIDE tracer lathe applications in your plant. Or, write us direct.

Improved Machining Through Research

CINCINNATI LATHE AND TOOL CO.

3207 Disney Street • Cincinnati 9, Ohio

"TRAY-TOP" Lathes / "CINCINNATI" Drilling Machines / "SPIROPOINT" Drill Sharpeners

30% TO 50% LONGER LIFE FOR RESINOID-BONDED DIAMOND WHEELS

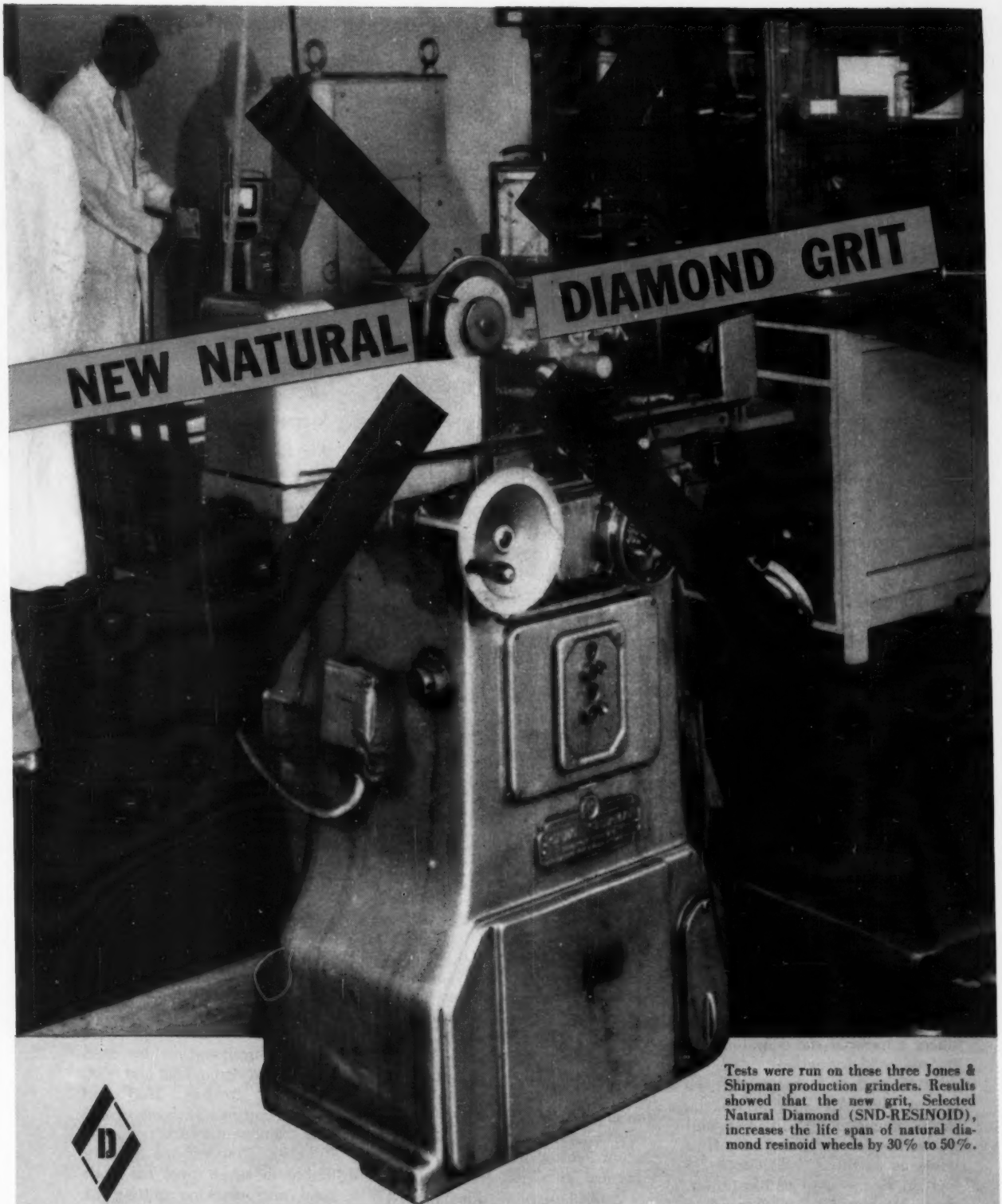
Six hundred separate trials, using 145 wheels, were run by the Diamond Research Laboratory to test a completely new type of natural diamond grit for resinoid wheels. The results: this new grit increases the life of natural diamond resinoid-bonded wheels by 30% to 50%.

The particles of this new grit do not readily pull out of the bond. Instead, they break down into ever-finer fragments which constantly expose new, sharp cutting surfaces.

TEST EQUIPMENT: Three 18" Jones & Shipman production grinders were fitted with special spindles to enable wheels to operate at 5500 surface feet per minute, the speed generally used in diamond grinding.

The wheels were of the D1A1 type, 6" in diameter, 3/16" face width, with 1/8" depth of resin. Each wheel contained 31 1/4 carats of the new grit. Metal to be ground was tungsten carbide of the same quality normally used for milling cutters, lathe tools, etc. During the course of the tests, 700 pounds of hardest carbide were ground away.

RESULTS: This new friable grit, Selected Natural Diamond (SND-RESINOID), increases the life of natural diamond resinoid wheels by 30% to 50%, depending on the type of job at hand. The grit will be available to your wheel manufacturer soon. Next time you order diamond resinoid wheels, specify SND-RESINOID . . . the most economical *and* the most efficient grit you can use.



Tests were run on these three Jones & Shipman production grinders. Results showed that the new grit, Selected Natural Diamond (SND-RESINOID), increases the life span of natural diamond resinoid wheels by 30% to 50%.

INDUSTRIAL DISTRIBUTORS (SALES), LTD.

YOU CAN DEPEND ON NATURAL DIAMONDS

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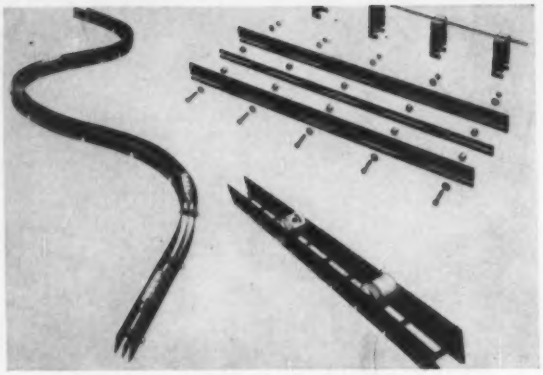


"FabriFlex" chuting for gravity-fed rolling or sliding parts introduced by F. Jos. Lamb Co.

Heliwelding outfit for small shops announced by the Air Reduction Sales Co.

uncontrolled melting when making butt, lap, or fillet welds in thin-gage material, a constant potential power-supply unit incorporating a drooping characteristic was developed. With this power unit, surge currents can be controlled to limit the time duration of arc, prevent wire ejection, and produce a stable arc. This arc, operating in the range of 30 to 125 amperes, 14 to 19 volts, short-circuits dozens of times per second, producing a small cold puddle that pinpoints the location of the arc heat and enables the welding of thin materials in all positions. It is used primarily with 0.030-inch-diameter wire, although 0.020-inch-diameter hard wire works well on material in the very low end of the thickness range.

With respect to shielding gases, argon has proved suitable for most metals such as aluminum, copper, and Everdur. For stainless steel and carbon steel, argon-oxygen and argon-carbon-dioxide mixtures are finding wide acceptance. Pure carbon dioxide is being used for some steel applications, but it produces somewhat more spatter and poorer bead formation.

An important factor in the success of "Short-Arc" welding was the development of both manual and mechanized equipment to feed wires as small as 0.020 or 0.030 inch in diameter. The illustration shows a Sigma ST-2 torch welding 16-gage carbon steel at the rate of 18 inches per minute in the overhead position by the "Short-Arc" method.

Circle Item 603 on postcard, page 199

Chuting for Gravity-Feeding

A new development in chuting for gravity-feeding of rolling or sliding parts has been announced by F. Jos. Lamb Co., Detroit, Mich. This patented chuting, called "FabriFlex," consists of spring-steel side- and ride-rails that provide adequate structural strength. Features include extreme flexibility of installation and versatility of part application. No shop fabrication is necessary as bolted construction eliminates the need for special-design chuting and permits rapid assembly from standard components to suit any part configuration, plant layout, or process sequence.

Installation requires no special skills or tools. Plant layout drawings and precise measurements are not required as FabriFlex can be routed around building obstructions and cut to length at the time of installation. This chuting can be used with feeds of the fixed, oscillating, or reciprocating type.

The rails are of highly polished spring steel, which minimizes friction and wear, and allows the parts to move freely. The chuting normally lasts longer than the equipment with which it is used. Once installed, no maintenance or attention is required. The open-channel design allows machining chips and foreign matter to drop through. Electrical interlocks for automatic flow control can be readily mounted by using the chuting assembly bolts. Fabriflex is available in standard widths and in coils of any length.

Circle Item 604 on postcard, page 199

Airco Heliwelding Outfit

Air Reduction Sales Co., New York City, recently placed on the market a low-priced, tungsten inert-gas welding outfit called the "Helicraft 100." This outfit is specifically designed for use in small shops by small sheet-metal fabricators, auto repairmen, and plumbers. It can be operated from any conventional direct-current power source for producing quality welds on light-gage stainless steel, aluminum, brass, copper, nickel, Monel, silver, and all other non-ferrous metals. A newly developed, fixed-flow pressure regulator, with flow adapters that give automatic control of gas flow to prevent needless waste of inert gases, is included in the kit. Airco's argon, helium, or AG75 (75 per cent helium, 25 per cent argon) can be used as shielding gases.

A new line of tips for flame-cutting with natural gas and propane is another recently announced development of the Air Reduction Sales Co. Designated Style 260 straight bore and Style 360 divergent "Hi-speed," these tips were specifically designed to be used with standard Airco 3000 and 9000 hand-cutting torches, 3700 and 3800 hand-cutting attachments, and 4700 machine-cutting torches.

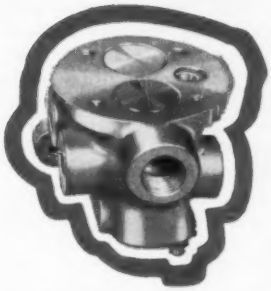
Style 260 straight-bore tips are available in seven sizes for both manual and machine cutting of thicknesses up to and including 12 inches. Divergent "Hi-speed" tips, Style 360, are available in eight sizes for machine cutting.

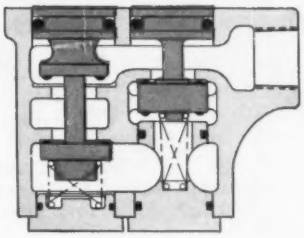
Circle Item 605 on postcard, page 199

(This section continued on page 220)

a basic **Ross**
valve building block

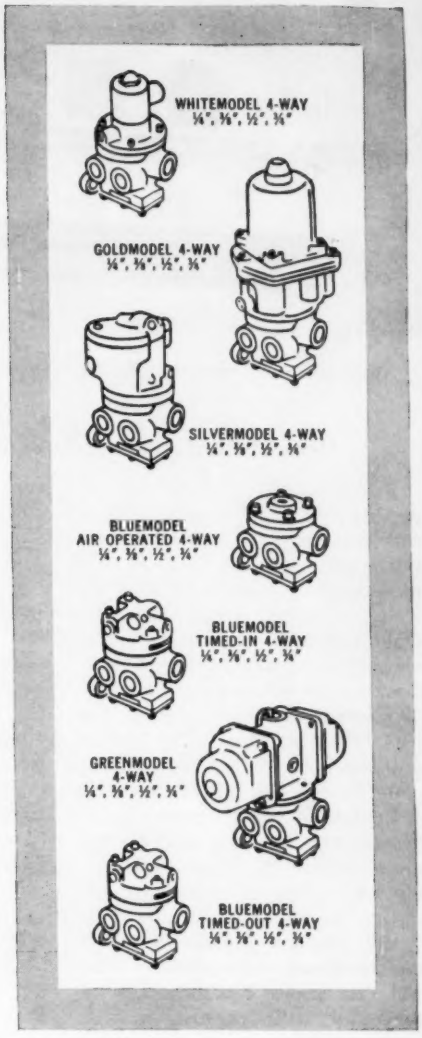
4-way inline mounted valve body





- **Compact—saves space**
- **Ross quality**
- **Costs much less than base mounted 4-way**

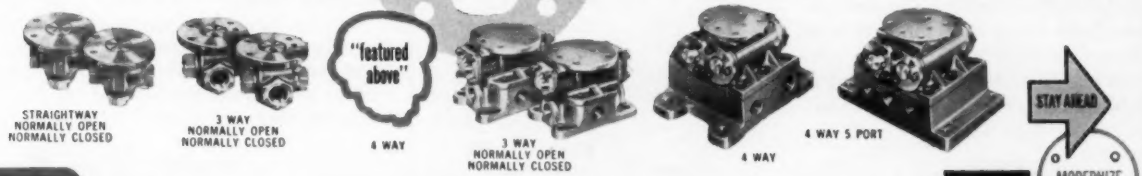
Lots of designers use this valve where they must save space. It was designed specifically for compactness! Others use it to save money *without sacrificing* quality—when J.I.C. allows the usage of an inline valve, it meets J.I.C. specs. It's a unit of the Ross Skyline series which features modular construction, so it can be actuated with any Skyline series head. Ross poppet construction means pressure assists the seal, and short poppet travel gives faster response. On most applications it outlives the machine—and frequently doesn't even require maintenance. Write for Bulletin 321.



* WHITEMODEL SPOOL SOLENOID
* GOLDMODEL OIL-IMMERSED SOLENOID
* SILVERMODEL JIC SPOOL SOLENOID
GREENMODEL DOUBLE SOLENOID MOMENTARY
BLUEMODEL AIR OPERATED
BLUEMODEL AIR-OPERATED MOMENTARY ADAPTOR
BLUEMODEL AIR OPERATED TIMED IN
BLUEMODEL AIR-OPERATED TIMED-OUT
*THIS AIR INDEX ADAPTOR CONVERTS THESE HEADS TO MOMENTARY ACTION

"every head meets every body at this gasket"

ALL SKYLINE HEADS AND BODIES ARE BUILDING BLOCKS TO GIVE YOU MANY VALVES FROM A FEW HEADS AND BODIES



STAY AHEAD
MODERNIZE

ROSS OPERATING VALVE COMPANY
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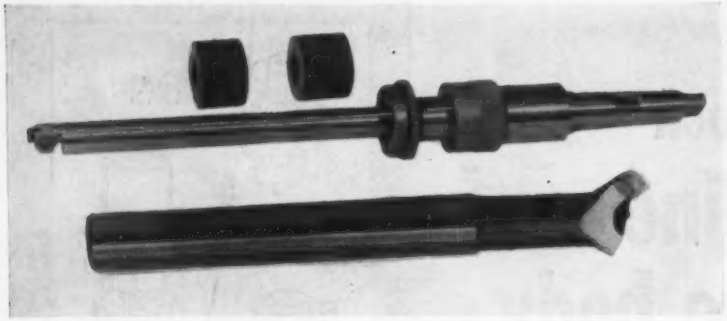


(Top) Maxwell deep-hole recessing tool. (Bottom) Form-relief boring cutter

Deep-Hole Recessing Tool and Boring Cutters

Fully automatic deep-hole recessing with a high degree of accuracy can be done without a supporting jig by means of the JS type recessing tool brought out by Maxwell Industries, Inc., Ashtabula, Ohio. This tool, shown in the upper view of the accompanying illustration, can be used with any number of nose-piece extensions to fit the part being machined. The tool is supported rigidly at the cutting point to give exceptional accuracy in operations which heretofore required extra handling to complete the work from the opposite side or the use of supporting jigs at extra cost.

Any annular internal forming can be done automatically. The tool can be used with radial or horizontal drill presses, milling machines, jig borers, turret lathes, and other types of lathes. It is designed for use with, or without, fixtures. Equipped with relatively high-feed ratios, it can be used with manual, mechanical, or automatic feed. Also, it can be used to machine a number of internal forms simultaneously. By the use of spacers, it can produce a series of forms in various locations in the same piece without having more than one holder. Through the use of self-lubricating bronze bushings of different diameters, the tool can be adapted to a wide range of hole diameters. Ball-bearing stops prevent marring either the work or the fixture. The diameter is controlled by stop collars threaded onto the body.

Increased cutting feeds, longer tool life, and finer surface finish are said to be possible with the form-relief line of Maxwell boring cutters of the design shown in the lower view of the illustration. These tools are available in both high-speed steel and carbide-tipped styles. They are moderately priced and feature an advanced spiral-relief design that tends to make the chip curl and break up easily so that it is flushed out along the shank of the tool. Especially adapted for internal work, this tool maintains a constant clearance angle throughout its life. Extremely fine surface finish and uniformity are said to result from the precision chip-driver contour of the form-relief design. This line of boring tools is available in a complete range of sizes.

Circle Item 606 on postcard, page 199

Ball-Bearing Master Die Set

A ball-bearing master die set developed to reduce pressroom costs has just been announced by

(Continued on page 223)

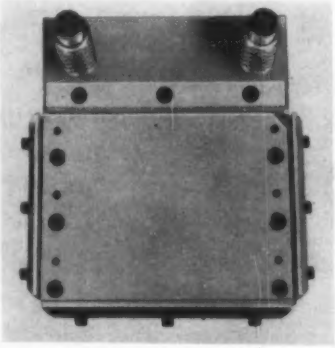


Fig. 1. Lempco ball-bearing master die set assembly

Superior spindle is major factor in accuracy of G&L horizontals

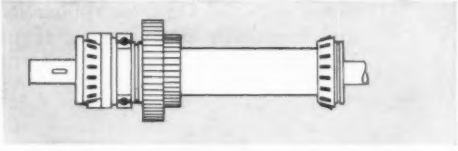
The ability of heavy-duty Giddings & Lewis horizontal boring, drilling, and milling machines to work to jig-boring accuracies on many jobs is made possible by superior spindle construction—and the over-all rigidity and precision of the machines.

Giddings & Lewis spindles ride in ultra-precision Timken 0-33 bearings. These are premium-priced bearings superior to those used in any other horizontal spindle.

Surface finish on Giddings & Lewis spindles averages between two and three microinches. Runout normally measures .0001 to .0002 TIR.

As illustrated in the drawing, the driving gear is shifted close to the front spindle sleeve bearing for slow-speed operation. This minimizes torsional deflection on the spindle. When the heavy drive gear is disengaged for high-speed operation, it provides a flywheel effect, essential for use of carbide tools.

The spindle is accurately supported by the sleeve, ram, and take-



up collet when used in extended position for milling.

When you look at the power and beef that backs up this precision spindle construction, it is not hard to see why G&L horizontals provide exceptional accuracy *and* versatility.

These are some of the reasons why these machines carry the highest trade-in value and the lowest piecework rates of any horizontals available today.

Add to these features use of the building-block principle which gives you more machine for your dollar, and you'll see why G&L is your top buy.

symbol for machining cost reduction

GIDDINGS & LEWIS

GLF-110 T. M.

For more data, circle this page number on inquiry card

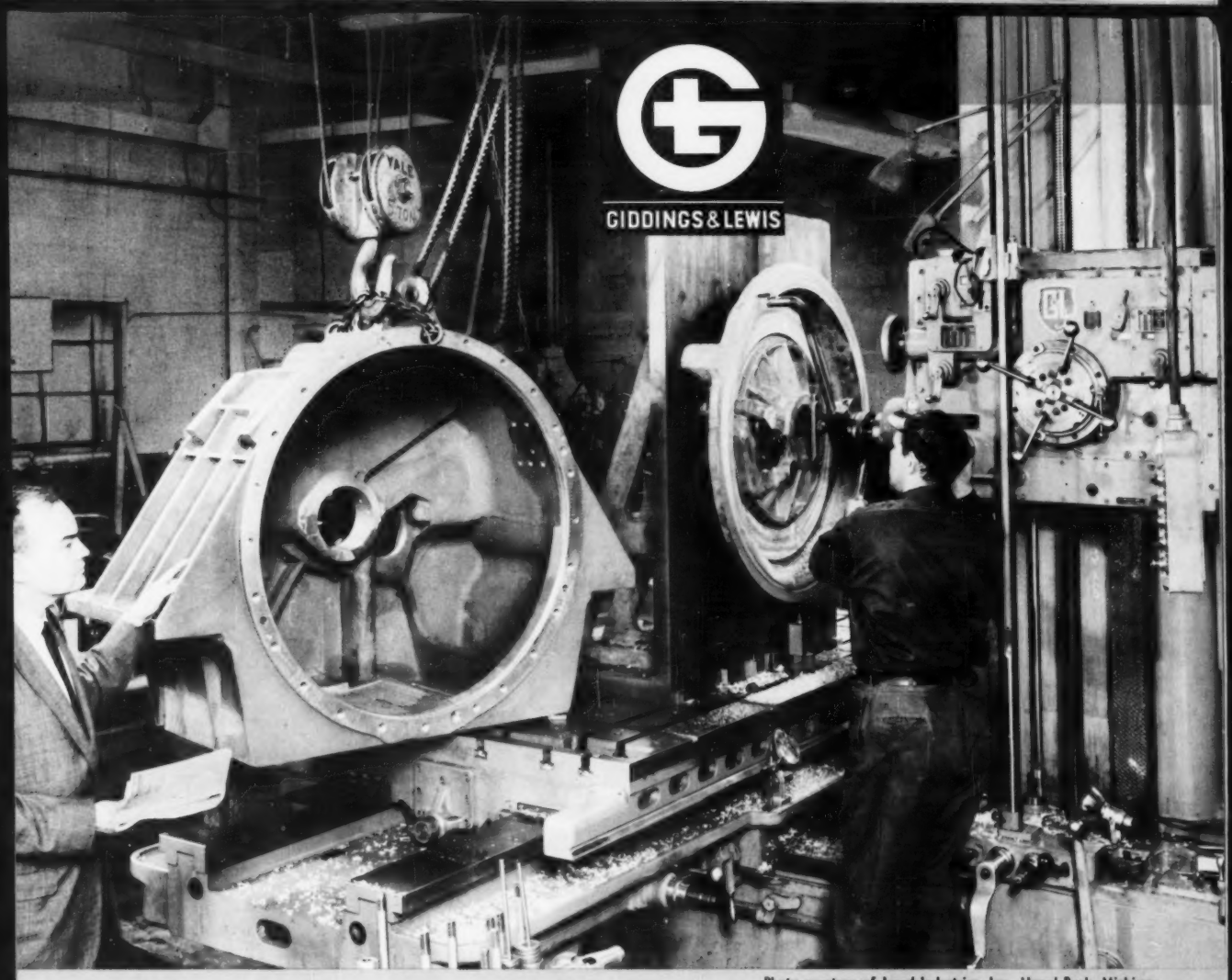


Photo courtesy of Jered Industries, Inc., Hazel Park, Michigan

G&L: for "tenths" accuracy on jobs like this

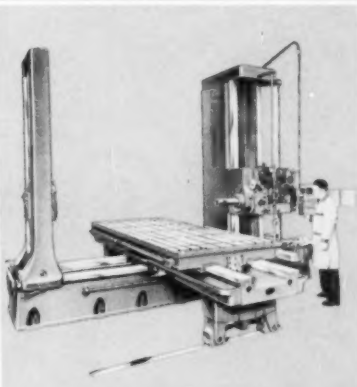
When you are determining the economic justification for a new machine, consider these facts about G&L horizontal boring, drilling, and milling machines:

Accuracy. For example, tolerances of ± .0001″ are being held on dowel spacings in the aluminum transmission housing above. A tolerance of .0005″ is readily maintained on bores.

Machines equipped with the fastest available timesaving automatic electric positioning systems are controlled to predetermined settings within ± .0001″, without final hand adjustments. This is made possible by positioning the table and headstock simultaneously. Addition of the Giddings & Lewis "Lubri-Cool" system, which dissipates heat generated in the machine, assures accurate repeatability all day long.

Versatility. With G&L bar machines, you can handle a tremendously wide range of work. minimize repositioning of workpieces, and frequently handle on the single machine jobs that otherwise would have to be handled on several less versatile machines. They are real metal hogs on heavy die work. They combine the rigidity, power, and ruggedness to take heavy milling cuts on large workpieces. G&L accessories enable them to do turning, boring, backfacing, keyway cutting, and angular milling. Saddle feed can be used for boring operations.

Few machines can give you a comparable return on your investment. For complete information, call your G&L distributor or write.



For accuracy plus versatility: G&L table-type horizontals.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

Fond du lac, Wisconsin

Vertical and horizontal boring machines, vertical turret lathes, planers, planer mills, contour milling machines, die sinking machines, drilling machines, numerical and tracer control systems, boring tools and related items, and machine tool accessories.

here comes real detergency

Stuart's new Hi-D

transparent metalworking compound

Hybrid compound keeps grinding wheels open and free-cutting, minimizes machine tool maintenance.

Now, today, there is a metalworking compound that offers extra-high detergency for stress-free grinding, yet does not attack paint, remove way lubricant, or leave crystalline deposits on the machine . . . that lubricates as it cleans, yet does not leave an oil film on the chuck . . . that is just as clear as any synthetic compound, yet is a petrochemical-type solution that is effective and stable at 60:1.

Hi-D is one of the outstanding lubrication developments in Stuart's 90-year history. Yet, it costs less per drum than most "coolants"—up to⅓ less at proper dilution than some high-priced cutting fluids.

No other cutting and grinding compound is anything like it. Best described as a hybrid, it has all the qualities you look for in a synthetic without any of the disadvantages.

Who uses it? Read the results obtained by a large bearing manufacturer on the opposite page.

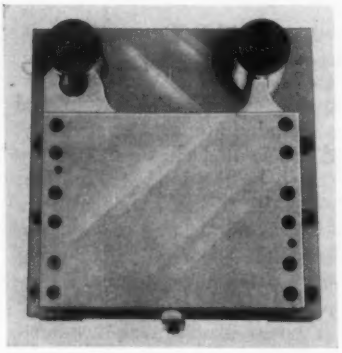


Fig. 2. Matching half of die assembly shown in Fig. 1

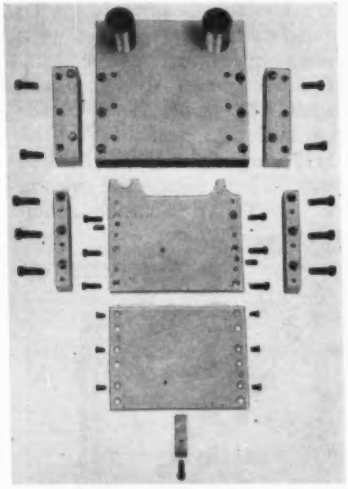


Fig. 3. Disassembled master die set unit shown in Fig. 2

Lempco Industrial, Inc., Bedford, Ohio. This die set, Figs. 1 and 2, offers complete interchangeability of its components.

Parts like those shown in the exploded view, Fig. 3, are interchangeable with like parts of every other Lempco master set. One master die set may be used for a number of dies, thus saving on die-set costs, as well as on storage and handling.

The Lempco unit features quick setup and easy change-over. It accommodates dies for processing all materials. The set incorporates Lempco's ball-bearing feature, which eliminates lubrication worries and guarantees accurate alignment of the dies for millions of working strokes.

Circle Item 607 on postcard, page 199

(This section continued on page 224)

Stuart's Hi-D cleans, lubricates as it cools, inhibits rust even at 60:1

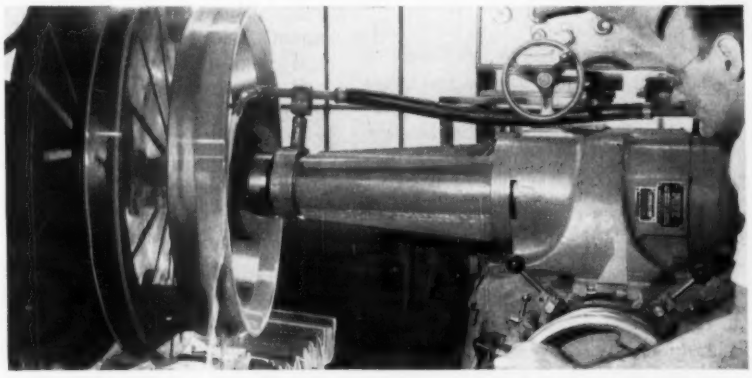
If you do a lot of grinding, you want a highly detergent grinding fluid, don't you? And, if that's what you are using, your greatest opportunity to save lies in the elimination of machine trouble. Here's how Hi-D can help.

This new compound will reduce downtime for machine maintenance because it does not wash lube oil from way surfaces or remove paint. It will reduce downtime for wheel dressing because it keeps wheels free-cutting. And, it will reduce downtime for cleaning the machine because it does not leave crystalline deposits on the chuck or table.

In a flotation-type filtering system, Hi-D has proved its ability to float the "fines" ... and, in an ordinary sump, it has shown excellent chip-settling qualities.

Even for hogging cuts on a surface grinder, Hi-D has all the detergency needed to keep your wheels open, yet does not make them act too soft. You don't have to go into a big wheel program to use it. Mixed at 60:1 for grinding, it slashes lubrication costs, inhibits rust, and remains stable even after picking up tramp oil.

You can standardize more effectively and simplify inventory, too, because Stuart's Hi-D at 40:1 is an excellent cutting compound—has proved its effectiveness on threaders, lathes, and other cutter-type operations. It handles a wider range of operations than most synthetic compounds because it lubricates as it cools.



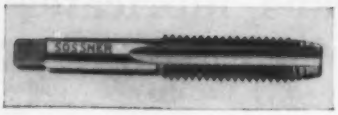
***Proof of performance**—Grinding wheels stayed clean and free-cutting 3 times longer when Stuart's Hi-D was used in this universal gap grinder and other machines at The Torrington Co., Bantam Bearing Division, South Bend, Indiana. This precision bearing manufacturer found it to be the one best fluid for the average condition on 87 grinders. It reduced grinding fluid costs by ⅓ because it is more effective at 60:1 than the former, more expensive lubricant was at 40:1. Phone your Stuart representative for information on our introductory Trial Drum Guarantee.*

Stuart **Productive Lubrication**

D. A. STUART OIL CO., LIMITED

2727 South Troy Street, Chicago 23, Illinois • Phone: Bishop 7-7100

CANADIAN D. A. STUART OIL CO., LIMITED, P. O. Box 430, 43 Upton Road, Scarborough, Ontario, Canada



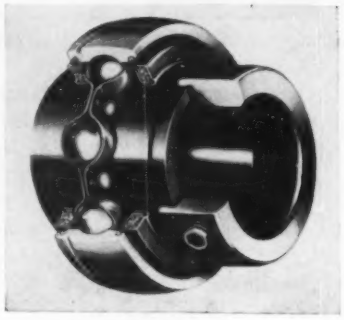
Triple-Tempered Taps

Sossner Tap & Tool Corporation, Lynbrook, N. Y., has announced the successful development of an exclusive "Triple Temper" process now applied to all taps manufactured by them. It is said that the taps now have a proved, increased resistance to chipping and breaking. The initial hardening process has been successfully modified to yield a basic structure with a "toughness potential" not previously attained. Triple Tempering further develops this "toughness potential" into the extra, final toughness given this product.

Circle Item 608 on postcard, page 199

Hoover Bearing with Shaft Lock

Eccentric-collar, shaft-lock ball bearing unit equipped either with spherical seat for automatic self-alignment as shown or with a straight outer diameter for more rigid, accurate shaft location. Recently announced by the Hoover Ball & Bearing Co., Ann Arbor, Mich. The collar, which secures the unit to the shaft, is a self-tightening, eccentric type that provides easy and positive locking upon installation. All units are factory-lubricated and equipped with three-piece, combination felt seals that effectively retain the lubricant and exclude contaminants. Bearings are offered either sealed for life or with lubricant channels in



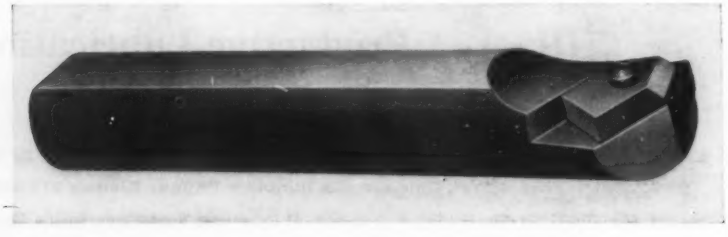
the outer bearing to provide for relubrication. These precision-made machine unit bearings with extra-smooth "Hoover Honed" raceways and high-quality "Micro-Velvet" balls are available in thirty-two shaft sizes ranging from 3/4 inch to 2 15/16 inches.

Circle Item 609 on postcard, page 199

Wesson Boring-Bar

One of two styles of standard non-adjustable boring-bars which use throw-away carbide inserts, announced by the Wesson Co., Ferndale, Mich. These tools complement the lines of standard "Micro-Adjustable" boring-bars made by this company. The new styles, AS and AT, are designed for operations that do not require micro-adjustment of diameter and are available with either negative or positive 5-degree rake. Both styles are available in either right- or left-hand styles. The clamps can be of either steel or carbide. Style AS boring tools are used with square throw-away carbide inserts for straight boring. Style AT tools are used with triangular inserts for boring and facing operations. All non-adjustable boring tools have carbide anvils and are available in standard sizes from 1 3/4 to 3 inches. Carbide-tipped chip-breaker clamps are available on special request.

Circle Item 610 on postcard, page 199

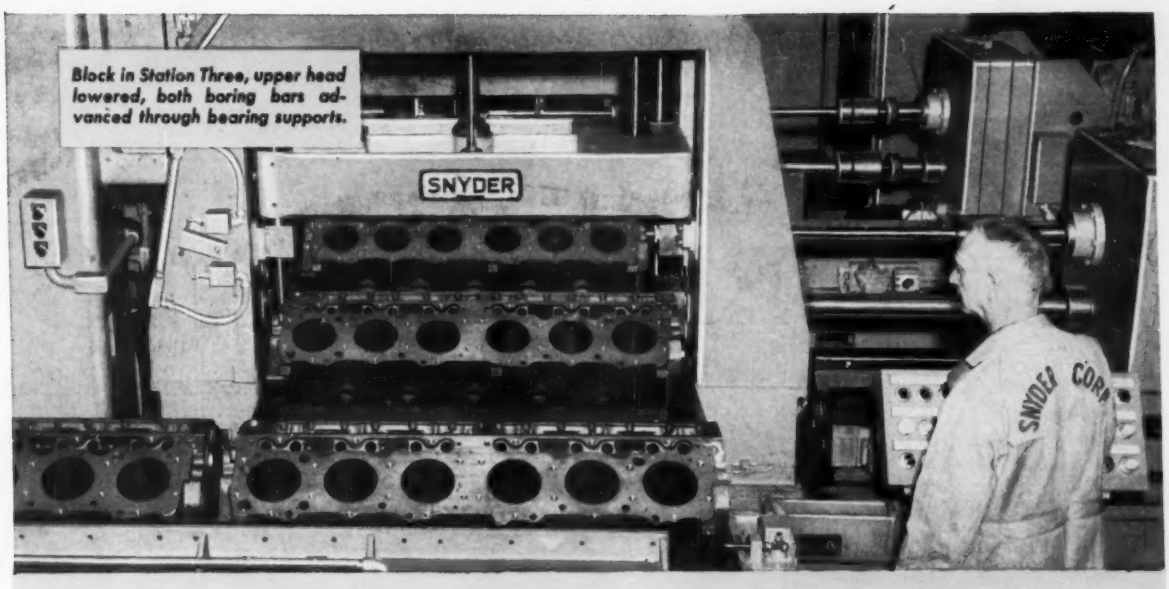


DoALL Taps of "Hy-Spiral" Design

Taps of "Hy-Spiral" line designed for extended life, greater accuracy, and accelerated chip removal, announced by the DoALL Co., Des Plaines, Ill. These taps feature a 52-degree spiral angle which provides high shear at the cutting point and uninterrupted chip ejection. This characteristic, coupled with the 10- to 12-degree face hook and chamfer of 2 to 2 1/2 threads, is said to produce extremely smooth, accurate threads in even the most difficult-to-machine materials. With these taps it is claimed that stringy and high-temperature alloys such as the stainless steels, boron steels, Monel, Hastelloy B, Inconel X, and ductile steels, such as annealed SAE-1018, C-1117, etc., can be tapped to close tolerances with substantial gains in tool life. The free-cutting action

and positive control of chip flow make these taps especially suited to both aluminum and zinc die castings, especially when blind holes are tapped in the vertical position. While designed for tapping deep, blind holes, they can also be used to advantage in tapping open holes in metals that tend to clog and foul taps of conventional design. The Hy-Spiral line of taps in standard sizes, priced the same as standard spiral taps, includes both NC and NF pitches in machine screw sizes from No. 3 through No. 12, and fractional sizes ranging from 1/4 inch through 1/2 inch.

Circle Item 611 on postcard, page 199



Block in Station Three, upper head lowered, both boring bars advanced through bearing supports.

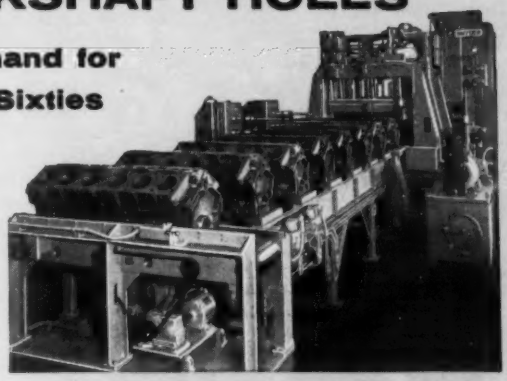
PRECISION BORING OF 42" LENGTH CAM AND CRANKSHAFT HOLES

SNYDERIZING Meets the Demand for Quality Parts for the Soaring Sixties

This 12-cylinder block is for heavy duty truck and marine engines aimed at taking a bigger bite of this booming market. Our Snyder special 7-station machine is helping this manufacturer SNYDERIZE for the Soaring Sixties by providing boring tolerances which make his product outstanding.

In regular production at a rate of 31 pieces per hour, main and camshaft bearing holes are rough and semi-finish bored simultaneously with all diameters held to manufacturers' specifications for alignment, roundness and concentricity. The distributor hole is also semi-finish bored in this machine to establish proper location to cam and crank bores.

Advanced engineering, both in product and production machines, is the best possible preparation for the competition of the next decade. We'll be happy to show you, too, how to SNYDERIZE for the Soaring Sixties to gain more efficient parts handling, gaging, assembly and machining. Write or phone for new brochure on machines for profit improvement.



Standard Features of Snyder Machines

1. SNYDER UNITS equipped with hardened and ground steel ways.
2. Building block principle throughout.
3. Automatic lubrication.
4. Walking beam transfer bar.
5. J.I.C. Standards throughout.
6. Electrical interlocks and full depth circuit throughout.
7. Panels equipped with SNYDER CIRCUIT SLEUTH.

SNYDER
CORPORATION
(Formerly Snyder Tool & Engineering Company)
3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

For more data, circle this page number on inquiry card

By E. S. Salichs

BETWEEN GRINDS

Jest for Jets

The Metal Products Division of Koppers Co., Inc., is building five jet-engine test cells for commercial airlines, which will use them to protect airport neighbors and personnel from the high-pitched noise that jet engines produce during testing operations. Koppers, which pioneered in the suppression of jet noise, calls the cells "hush houses." Writing in for *your* neighbor?

Our Ordinary Order, or a Debatable Date

An Argentine subscriber has informed us of his bewilderment concerning the expiration time stated on the Business Reply Postcards in MACHINERY (used to request catalogues and data on new shop equipment and advertised products). He thought, for example, that 4/1 meant, not April 1 but January 4; and by the time he received MACHINERY it was always too late, he assumed, for him to send for the information he wanted. We did know that this interpretation of dates existed outside the United States, but now, to avoid confusion, the month will be spelled out. Gracias, Senor Miguel Mina.

Rolling Out History

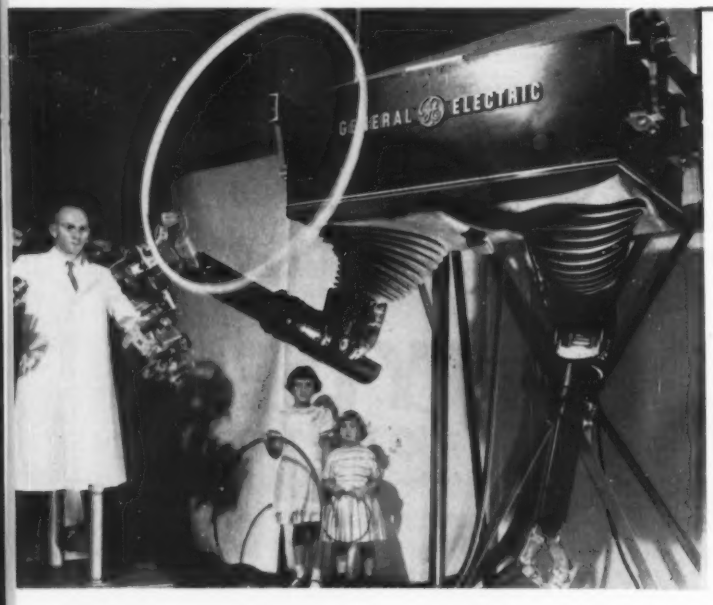
It all began with a set of drawings that Henry Timken, owner of a carriage company, handed to his two sons one day back in 1895. Bearings at that time were of the straight roller or ball type, able to withstand radial loads but not adequate for thrust loads. The drawings showed how to distribute wear over a larger area by tapering the roller. His sons then made the first set of tapered roller bearings by hand and assembled the set on a wagon, loaded it, and had it pulled by two small mules through the streets of St. Louis. In less than an hour, the driver was arrested, charged with cruelty to animals. The bearings were demonstrated in court, the judge was convinced, and the case was dismissed. And eventually two companies emerged—the Timken-Detroit Axle Co. and the Timken Roller Bearing Co., still active in our industry.

Burning Question

An aeronautical research scientist recently stated at an A.S.M.E. meeting that, if American aircraft is to match or surpass its competition, petroleum as fuel for jet engines must be replaced by another energy source, possibly burnable metals. But which? Boron, beryllium, aluminum, graphite?

Steel Gets New Look

A frosty finish, developed by Stamping Service, Inc., is being used on auto-trim sections of stainless steel. So Allegheny Ludlum Steel Corporation tells us, which company is watching the process being applied to its steel. Stamping Service, Inc., engineers will not disclose the method of applying the finish. Real frosty about that, too.



THE G-E HANDYMAN—which is demonstrating how it can twirl a hula hoop—is being proudly shown off by Ralph Mosher, "father" of the machine developed in the General Engineering Laboratory of the General Electric Co. But as a "mechanical man," it performs many more serious functions, serving as a master mechanic on an atomic-aircraft power plant and working in radioactive areas where man cannot endure. Handyman bends its arms, and folds and unfolds its powerful hands to manipulate objects of almost any shape. The arms have a 9-foot reach. Some master-slave device . . . and let's keep it that way!

Kaiser Aluminum doubles capacity with new Bliss hydraulics

Unusual control system provides broad job shop work range in both hand and closed die forging ... This 8,000-ton Bliss Hydro-Dynamic* press, together with similar 3,000-ton and 5,000-ton presses, are the key units in the recently completed $5 million press department at Kaiser Aluminum & Chemical Corporation's Erie, Pa., plant. The presses have doubled Kaiser Aluminum's capacity to produce a broad range of aluminum forgings for commercial applications, as well as for aircraft and missile components.

In spite of their size, the presses have unusual flexibility: the multiple cylinder design of the two larger units and novel automatic control systems provide precise, stroke-after-stroke regularity of forging speed and pressure.

What's your press need? In everything from bench presses to giant hydraulics, you'll find the greatest reliability ... and the most advanced engineering ... in a Bliss.

*Registered trademark E.W. Bliss Company

BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name—it's a guarantee

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CONTAINER MACHINERY • CONTRACT MFG.

For more data, circle this page number on inquiry card

News OF THE INDUSTRY

California

TORRINGTON MFG. CO., Torrington, Conn., announces that MACHINE SALES WEST has been formed as a subsidiary company at its Western Division plant in Van Nuys, Calif. Headed by M. A. JOULSOHN, vice-president and general manager of the Western Division, the new sales organization is responsible for sales and service west of the Mississippi River of all metal-forming equipment produced by Torrington's Machine Division. Field sales activities of Machine Sales West are supervised by WILLIAM MCFARLANE.

AIR REDUCTION PACIFIC CO., a division of Air Reduction Co., Inc., San Francisco, Calif., announced that H. W. SAUNDERS, who has been with the company since 1918 and district manager and vice-president in charge of the San Francisco district for the past twenty-seven years, reached the company's mandatory retirement age on June 1. He will be succeeded by L. A. HAMILTON, vice-president in charge of the Seattle, Wash., district.

HAMILTON TOOL CO., Hamilton, Ohio, announces the appointment of the TORNQUIST MACHINERY CO., 864 Burlway Road, Burlingame, Calif., as exclusive distributor for the northern California territory. The appointment coincides with the opening of a San Francisco office by the Tornquist organization, which has been a Hamilton distributor in the Los Angeles area.

FRANK L. BAILEY and E. LAWRENCE BREVIK have announced the formation of CHEMICAL MILLING AND INTERNATIONAL CORPORATION, Los Angeles, Calif., to be engaged in the production, consulting, and research of chemical milling. The company's operations will be international in scope. A third principal in the new company is ROBERT VULCAN, who will act as administrator, supervising all business and financial matters.

CLEVELAND PUNCH & SHEAR WORKS CO., Cleveland, Ohio, has announced the appointment of TORNQUIST MACHINERY CO., Burlingame, Calif., as its exclusive dealer in the San Francisco area. Tornquist also represents Cleveland Punch & Shear in southern California through its main office in Los Angeles.

ALFRED C. EKBERG has been named district manager at the San Francisco office of PRATT & WHITNEY CO., INC., Hartford, Conn. He succeeds ERNEST P. HAQUETTE, who retired in June after forty-two years of service.

ACE DRILL BUSHING CO., INC., Hollywood, Calif., announces that construction is under way for its new plant in Arlington, Calif. The facility is being built at the corner of Pierce Ave. and Rindge Road. Completion and occupancy is expected some time in July.

BENCHMASTER MFG. CO., Gardena, Calif., has made the following appointments. ED LIBBY has been made chief engineer. WENDELL C. NORTHERN assumes responsibilities as plant superintendent.

JACK R. WALCHLI has been appointed manager of the Licensing and Research Department of NAVAN PRODUCTS, INC., El Segundo, Calif., North American Aviation subsidiary.

Illinois, Indiana, and Missouri

SUPER TOOL CO., division of Van Norman Industries, Detroit, Mich., announces that ROY C. MATZEN has been appointed division manager of the new Chicago area industrial cutting tool center opened by the company. The new warehouse is located at 5428 North Milwaukee, Chicago. JOHN MCKELVIE will assist Mr. Matzen as warehouse office manager.

UNIMET CARBIDES division of United-Greenfield Corporation, Chicago, Ill., has appointed the following as distributors: MACHINIST TOOL CO., 901 E. State St., Rockford, Ill.; WILLIAM T. MCBRIDE, INC., Athol, Mass.; MORTON TOOL CO., P. O. Box 2343, Buffalo 23, N. Y.; and NEAL & BRINKER CO., 28 Warren St., New York 7, N. Y.

RICHARD K. SCHRECONGOST has joined GREENLEE BROS. & CO., Rockford, Ill., as consultant to the B & T MACHINERY CO., Holland, Mich., a subsidiary of Greenlee Bros. & Co. He will make his headquarters in Rockford.

IRWIN W. KILLIAN was elected president and chief executive officer of PINES ENGINEERING CO., INC., Aurora, Ill. Mr. Killian succeeds B. F. BOWER, who died in May.

WILTON TOOL MFG. CO., INC., Schiller Park, Ill., has announced the appointment of ALEX J. VOGL to the office of president, and WILLIAM FERRICK to the office of vice-president—sales manager.

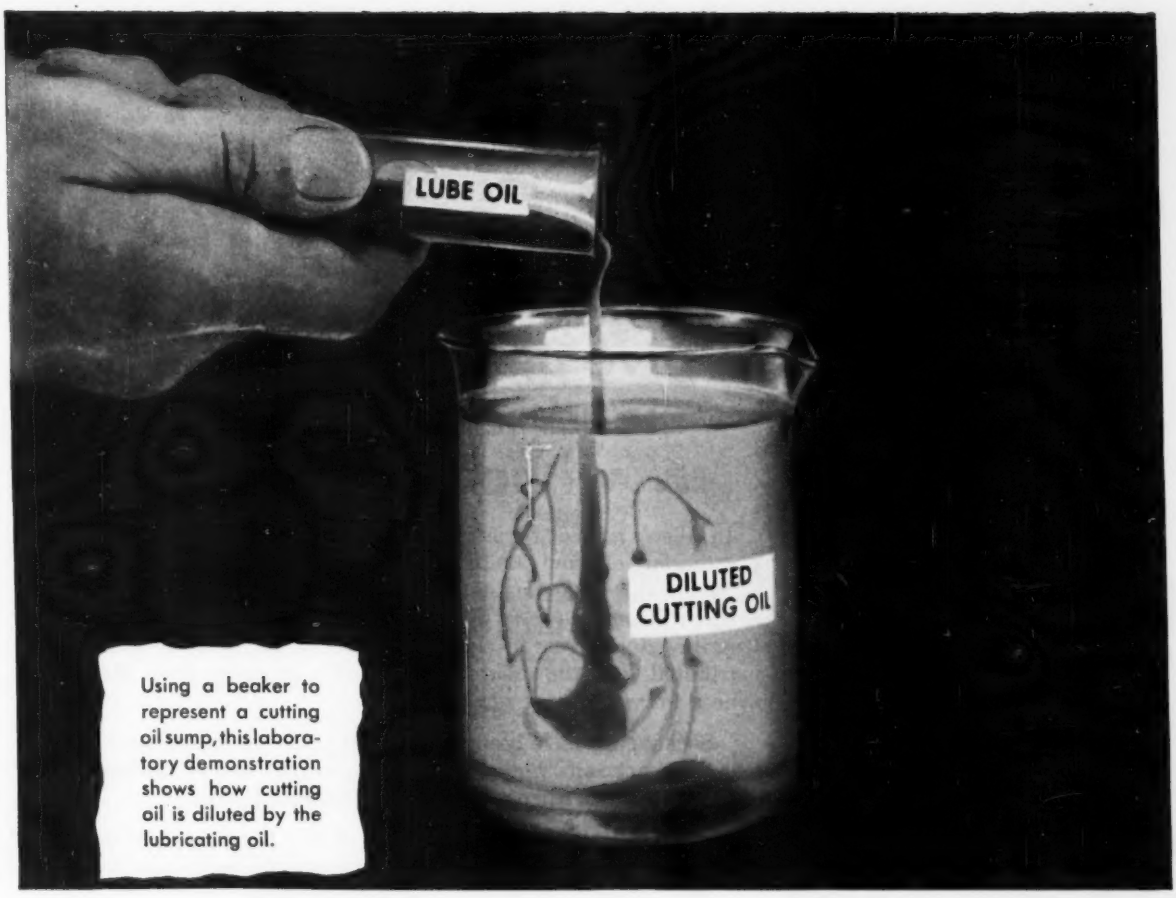
ELI LILLY & CO., Indianapolis, Ind., has reorganized its industrial products department by establishing eastern and western sales regions. NEIL E. FUNK, JR., has been named manager of industrial sales in states west of Ohio, and RAYMOND MEANS is manager of industrial sales in Ohio and eastern states. Messrs. Funk and Means will supervise sales of Elclide 75, Lilly's brand of bacterial inhibitor for cutting fluids, and other industrial chemicals. They will maintain headquarters in Indianapolis.

DAVID W. DEWEY has been named Atkins eastern division manager for ATKINS SAW DIVISION, Borg-Warner Corporation, Indianapolis, Ind. Mr. Dewey is responsible for supervision of distributor sales in Maryland, Delaware, Pennsylvania, New Jersey, New York, Connecticut, Massachusetts, Rhode Island, New Hampshire, Vermont, and Maine.

METALLURGICAL PRODUCTS DEPARTMENT, General Electric Co., Detroit, Mich., announces that JOPLIN SUPPLY CO., Joplin, Mo., will be an authorized distributor of its Carboloy cemented carbide products. Joplin Supply Co. is located at Third and Joplin Sts. Its territory includes sections of Missouri, Oklahoma, Kansas, and Arkansas.

MARVIN L. DUGGINS has been appointed branch manager of the St. Louis territory of the CARPENTER STEEL CO., Reading, Pa.

(This section continued on page 234)



Using a beaker to represent a cutting oil sump, this laboratory demonstration shows how cutting oil is diluted by the lubricating oil.

Diluted cutting oil can cut output 33%

No matter how careful your lubricating techniques, you still can't stop lube oil from leaking into the cutting oil sump on 70% of automatic screw machines. As cutting oil is diluted, it loses strength—ingredients that make it efficient become less and less effective. The natural consequence is shortened tool life, more downtime and a higher percentage of rejects.

Texaco Cleartex can end this problem forever. All you have to do is use Cleartex for both cutting *and* lubrication . . . and watch your production rise. The exceptional chemical stability and load-carrying ability of the Cleartex series make them equally suitable for use as cutting oils, lubricants and hydraulic fluids. (70% of all automatic screw machines can benefit from the "Cleartex Cure!")

TAKE THE CLEARTEX CURE SOON!

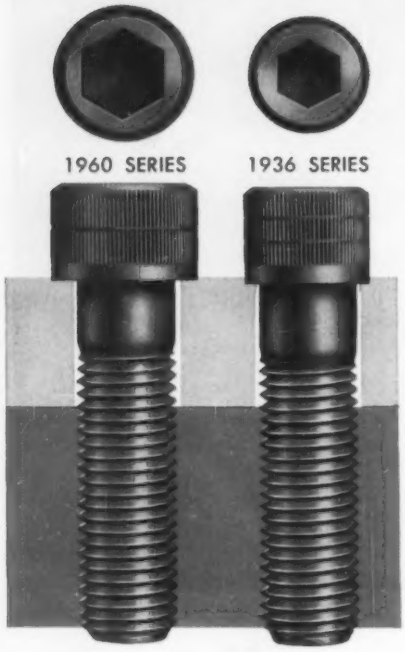
Write today for your copy of Texaco's new booklet—"Cleartex in Automatic Screw Machines." This new illustrated guide will fill you in on the details, show you where you may be losing profits and how to avoid it . . . Or contact your local Texaco Lubrication Engineer soon for an authoritative survey of your automatics. Just call the nearest of more than 2,300 Texaco Distributing Plants, or write to Texaco Inc., 135 East 42nd Street, New York 17, New York. Dept. MA-12.

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

For more data, circle this page number on inquiry card

Allen's *New '60 Series* Socket Head Cap Screws



give up to 2⅓ times more load carrying capacity ...without indentation!

In Allen's new '60 Series, head diameter of sizes from ¼" up is now uniformly one and one-half times the body diameter. In many sizes (where this ratio was not called for by 1936 Series specifications) this will provide *more* under-the-head bearing surface, and a proportionate *increase* in clamping force. Loads are more evenly distributed, and the greater bearing area in many cases eliminates need for washers.

Socket sizes have been increased in many cases—greater wrenching area permits higher tightening torque—which resists fatigue failure, and lengthens the life of the threaded joint.

- A new 2-band knurl will identify all ALLEN Cap Screws (except Stainless Steel) that conform to the new '60 Series specifications. New labels on boxes will also identify these.
- The 1936 Series of Allen Cap Screws will continue to be available.

COMPARISON OF ALLEN 1960 SERIES AND 1936 SERIES SOCKET HEAD CAP SCREWS

SCREW SIZE	HEAD DIAMETER Minimum (inches)		BEARING SURFACE Minimum (square inches)		PERCENT OF INCREASE IN BEARING SURFACE[1]	TENSILE LOAD TO INDENT IN SOFT STEEL[2] (lbs.)		TORQUE INDUCED TENSILE LOAD TO INDENT IN SOFT STEEL[2] (lbs.)	
	1960 Series	1936 Series	1960 Series	1936 Series		1960 Series	1936 Series	1960 Series	1936 Series
¼	.365	.367	.044	.044	—	4,750	4,750	2,780	2,780
5/16	.457	.429	.070	.052	33	7,440	5,600	4,380	3,300
3/8	.550	.553	.111	.111	—	12,100	12,100	7,000	7,000
7/16	.642	.615	.140	.103	36	15,000	11,000	8,850	6,450
½	.735	.739	.183	.183	—	19,500	19,500	11,500	11,500
5/8	.921	.863	.293	.216	35	31,000	23,200	18,500	13,600
¾	1.107	.987	.424	.224	89	45,000	24,000	26,700	14,100
7/8	1.293	1.111	.585	.253	131	62,500	27,000	36,800	15,900
1	1.479	1.297	.768	.405	89	82,000	43,500	48,500	25,500

[1]Head tolerance revisions on Sizes #0 thru #10, ¼, 5/16, and ½ diameter have no significant effect on bearing surface or holding power of screws.
[2]Values based on .00025 inch indentation.

Ask your Industrial Distributor about ALLEN '60 Series Cap Screws. Write for samples and complete specifications. Ask for Bulletin G-25.

ALLEN MANUFACTURING COMPANY
Hartford 1, Connecticut, U.S.A.
Stocked and sold by leading industrial distributors everywhere

ALLEN HEX-SOCKET SCREWS HEAD

AMERICAN STANDARD DRIVING AND SPINDLE ENDS FOR PORTABLE AIR AND ELECTRIC TOOLS—5

(Percussion Tools Excluded)

Approved as American Standard October 29, 1958

III. Threaded Fastener Drives (Cont'd.)

4. Square Drives - Male

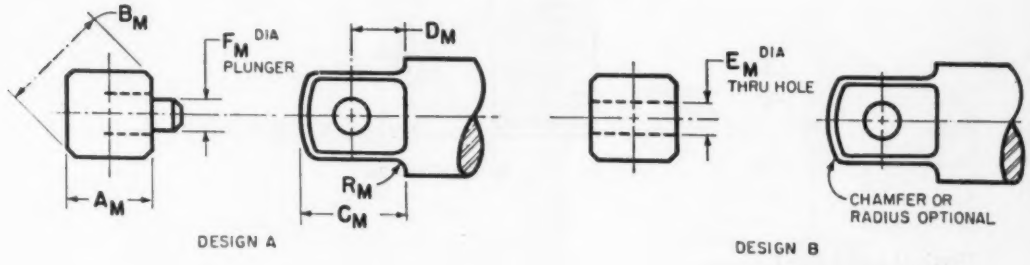


Table 6

Drive Size	Design	Male End									
		A_M		B_M	C_M		D_M		E_M	F_M	R_M
		Max.	Min.	Max.	Max.	Min.	Max.	Min.	Min.	Max.	Max.
Inch		Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch
1/4	A	0.252	0.247	0.330	0.312	0.265	0.165	0.153	. . . .	0.078	0.015
3/8	A	0.377	0.372	0.500	0.438	0.406	0.227	0.215	. . . .	0.156	0.031
1/2	A	0.502	0.497	0.665	0.625	0.531	0.321	0.309	. . . .	0.187	0.031
5/8	A	0.627	0.622	0.834	0.656	0.594	0.321	0.309	. . . .	0.187	0.047
3/4	B	0.752	0.747	1.000	0.938	0.750	0.415	0.403	0.216	. . . .	0.047
1	B	1.002	0.997	1.340	1.125	1.000	0.602	0.590	0.234	. . . .	0.063
1 1/2	B	1.503	1.498	1.968	1.625	1.562	0.653	0.641	0.310	. . . .	0.094

All dimensions given in inches.

Incorporating fillet radius (R_M) at shoulder of male tang precludes use of minimum diameter cross-hole in socket (E_F) unless female drive end is chamfered (shown as optional).

If female drive end is not chamfered, socket cross-hole diameter (E_F) shall be increased to compensate for fillet radius R_M (max.).

Minimum clearance across flats male to female is 0.001 through 3/4 size, 0.002 in 1 and 1 1/2 sizes. For impact wrenches A_M should be held as close to maximum as practical.

Extracted from American Standard Driving and Spindle Ends for Portable Air and Electric Tools (ASA B5.38-1958), with permission of publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

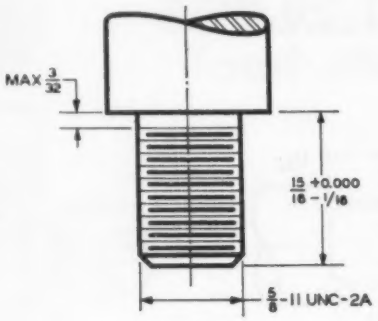
AMERICAN STANDARD DRIVING AND SPINDLE ENDS FOR PORTABLE AIR AND ELECTRIC TOOLS—6

(Percussion Tools Excluded)

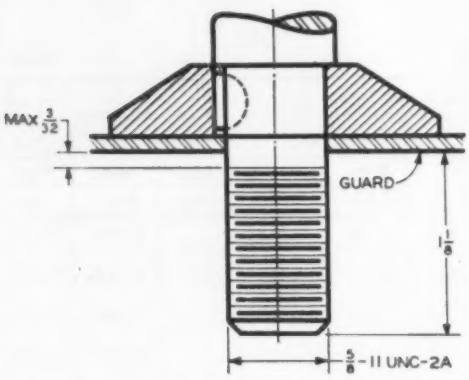
Approved as American Standard October 29, 1958

IV. Abrasion Tool Spindles

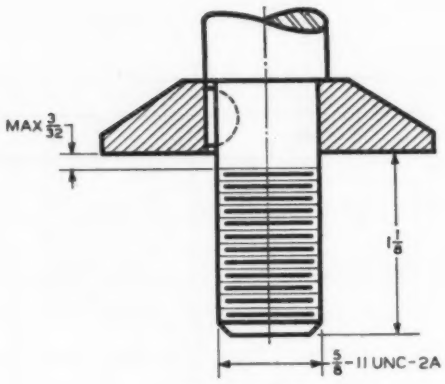
1. Sanders and Polishers



2. Vertical and Angle Grinders



WITH REVOLVING CUP GUARD



STATIONARY GUARD

(SEE APPENDIX C)

3. Cone Wheel Grinders

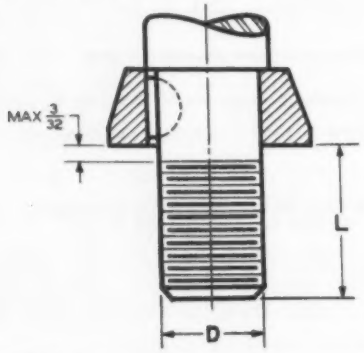


Table 7

D	*L*
3/8-24 UNF – 2 A	9/16
1/2-13 UNC – 2 A	11/16
5/8-11 UNC – 2 A	15/16

All dimensions in inches. Threads right-hand.

Extracted from American Standard Driving and Spindle Ends for Portable Air and Electric Tools (ASA B5.38-1958), with permission of publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

RUGGED PRECISE ECONOMICAL

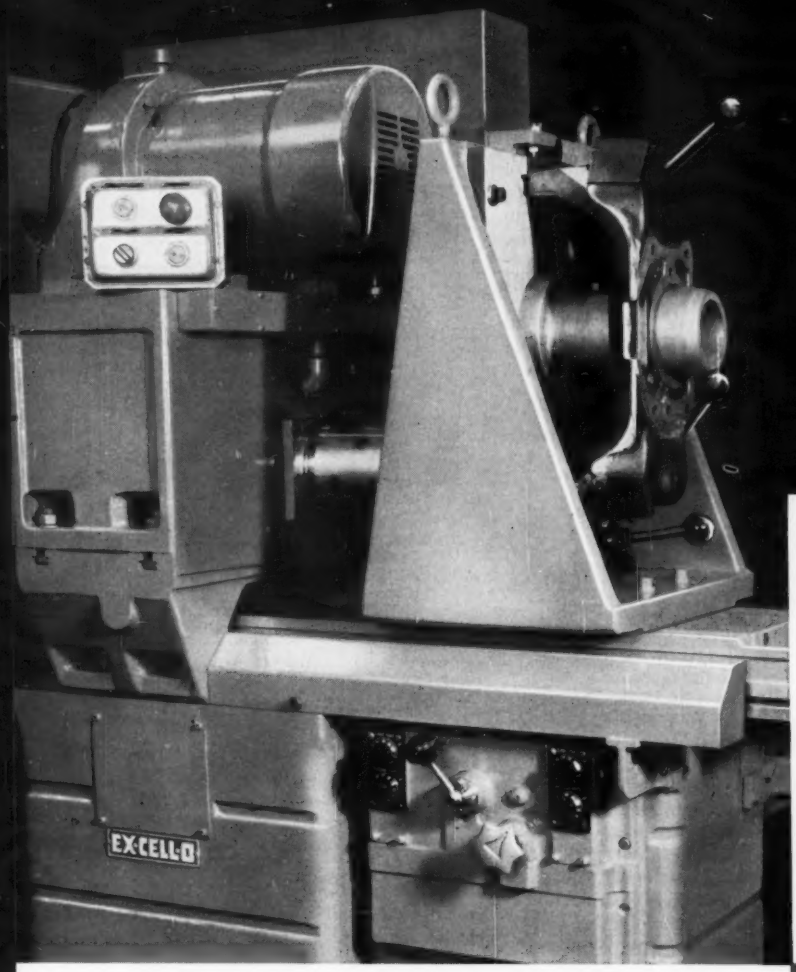
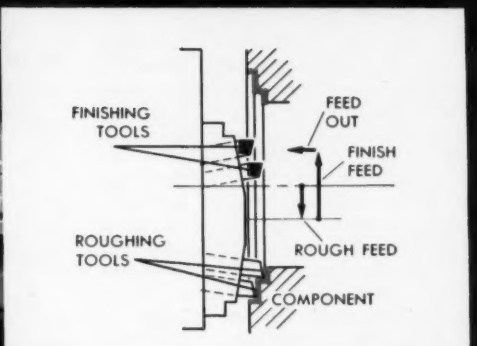


Table pad of the compact Style 2112-B provides ample space for this rugged fixture. Work is shown clamped in position.



Machining cycle and tooling are outlined above, with roughing tools shown fed to depth; finishing is done at opposite end of the feed stroke.

Starter motor mounting of this cast iron clutch housing is faced and bored from rough to finish in one cycle.

59-18

Ex-Cell-O Style 2112-B bores, faces heavy casting in a single cycle

RUGGED for roughing—PRECISE for finishing—ECONOMICAL for short runs

Precision built for boring, turning and facing small or medium-size parts, the Ex-Cell-O Style 2112-B Precision Boring Machine is equally adept at tackling a heavy cast iron truck clutch housing.

The job is done quickly and accurately in one cycle. After clamping, rapid traverse brings the work into position for roughing tools to face two shoulders and plunge two bores. Feed is reversed for finish facing, and table feed-out doubles as a finish-bore pass. A standard hydraulically-operated Ex-Cell-O Facing Head carries the tooling.

Find out how the Style 2112-B or the double-bridge Style 1212-B can put similar flexibility into *your* operation. Write direct, or ask your local Ex-Cell-O Representative about combining these rugged, time-tested Precision Boring Machines with low-cost tooling for real economy in long runs or limited production.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION Machinery Division
DETROIT 32, MICHIGAN

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT.

For more data, circle this page number on inquiry card

Michigan

METALLURGICAL PRODUCTS DEPARTMENT, General Electric Co., Detroit, Mich., announces that BRIAN SUPPLY CO., 111 Chestnut St., Providence, R. I., has been appointed an authorized distributor of its Carboloy cemented carbide products. Its territory includes Rhode Island, eastern Connecticut, and southeastern Massachusetts. Appointment of ABRASIVES & TOOLS, INC., Auburn, Mass., as distributor has also been made. It is located at 469 Southbridge St. in Auburn. Its territory includes Worcester County in Massachusetts and the entire states of Vermont and New Hampshire.

THE D. E. MILLER CO., Pontiac, Mich., has been newly formed by Don Miller to represent the various product lines of COLONIAL BROACH & MACHINE CO., Detroit, Mich., and its divisions from a sales and service standpoint in the Pontiac, Flint, Ann Arbor, Jackson, Saginaw, and Lansing areas, as well as in the northern portion of the lower Michigan peninsula. Headquarters of the new company have been established at 84 Auburn Road, Pontiac. Joining Mr. Miller are DENES PATAKI and JOHN CARPENTER.

N. A. WOODWORTH CO., Detroit, Mich., has appointed two new sales representatives. GEORGE W. DUKE will represent the company exclusively in northern and eastern Ohio and GEORGE T. LOTT will service the southern Ohio and Kentucky territory.

TOMKINS-JOHNSON CO., Jackson, Mich., has moved into its new manufacturing and office facilities at 2425 W. Michigan Ave., that city.

GLENN MASON has been appointed sales manager of the JES-CAL CO., Fraser, Mich., wholly owned subsidiary of the National Automatic Tool Co., Inc., Richmond, Ind.

M. J. STEFFES, vice-president of SUPER TOOL CO., Cemented Carbide Tool Manufacturing Division, Van Norman Industries, Detroit, Mich., has been elected executive vice-president.

EDWIN S. DYJAK has been named district manager of the Detroit office of PRATT & WHITNEY CO., INC., Hartford, Conn.

CHARLES "CAL" PETERSON was appointed chief engineer of VEET INDUSTRIES, Detroit, Mich.

New England

THOMAS E. MARQUARDT has been appointed sales representative for the E. W. BLISS CO., Canton, Ohio, in the New England area. Mr. Marquardt will handle those accounts formerly covered by W. E. METZGER. He will report to J. S. LOTT of the Bliss West Hartford office.

ANDERSON OIL & CHEMICAL CO., INC., Portland, Conn., has announced the appointment of ARNOLD W. ACKERMAN as vice-president and technical director. THOMAS M. PURTELL has been appointed vice-president and general manager of sales and a director of the company.

CHARLES T. PEELE has been appointed sales engineer for the CAPEWELL MFG. CO., Hartford, Conn., in the Wisconsin, Minnesota, and Iowa areas.

LAMINATED SHIM CO., INC., Glenbrook, Conn., announces the election of MICHAEL E. ERRICO to the position of assistant vice-president. He had been a sales engineer.

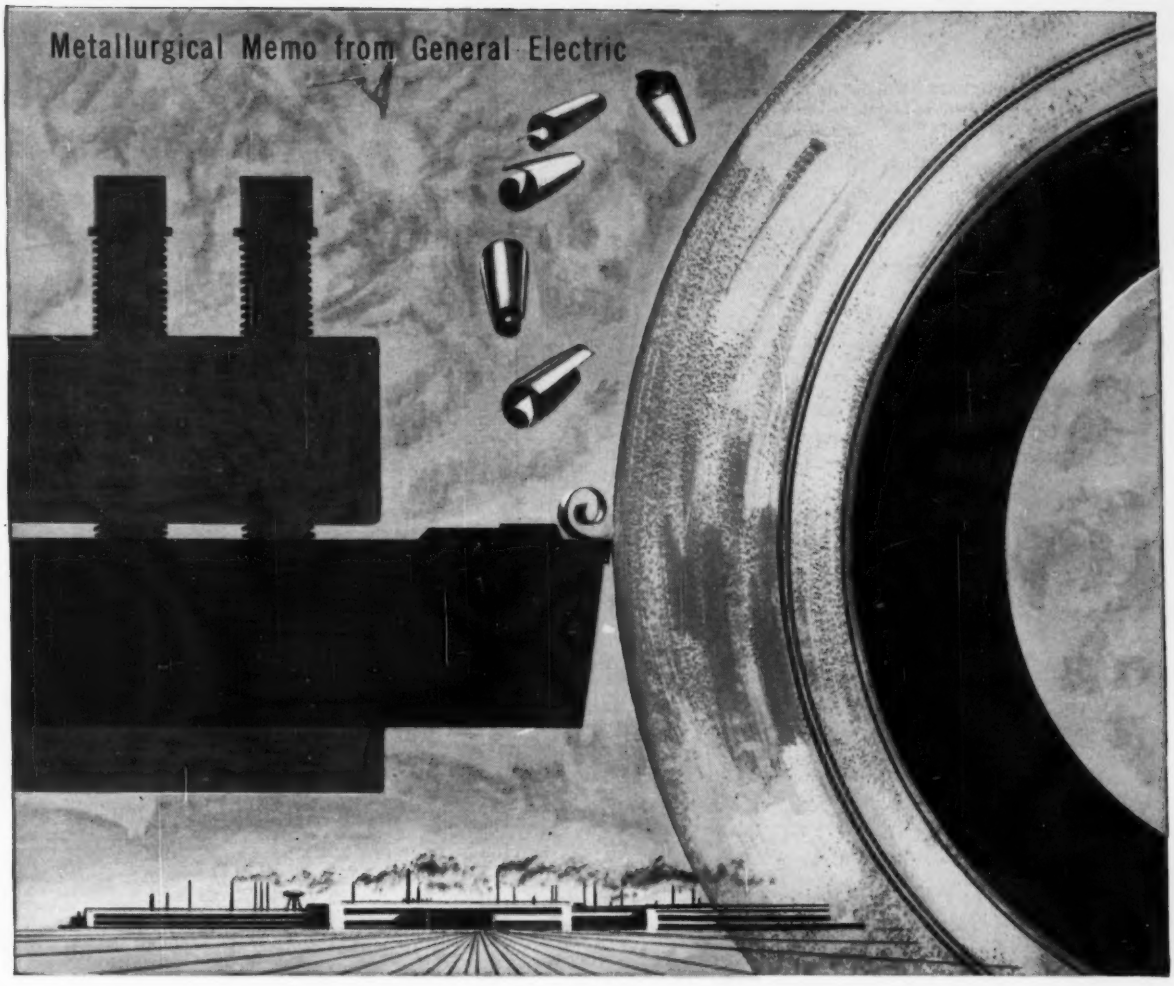
Michael E. Errico, newly elected assistant vice-president, Laminated Shim Co., Inc.

ROBERT E. BYXBEE has been appointed sales engineer. Mr. Byxbee will represent the concern in the New England-New York State area.

BROWN & SHARPE MFG. CO., Providence, R. I., announces the following appointments. CHARLES M. EVANS will join the company's subsidiary, Brown & Sharpe Ltd., Plymouth, England, on June 15. In the initial period of his foreign assignment, he will assist WILLARD SPENCE in the general management of its British branch. He will be succeeded in Providence as manufacturing manager, Machine Tool Division, by DUNCAN H. DOOLITTLE. A. DEAN HUNTER will assume new duties as division superintendent – Machine Tool Division. W. G. LEONARD will assume the position of superintendent–Screw Machine Group, and J. F. ROWLEY, superintendent–Milling and Grinding Machine Group.

(This section continued on page 238)

(Left to right) Duncan H. Doolittle, manufacturing manager–Machine Tool Division; A. Dean Hunter, division superintendent—Machine Tool Division; J. F. Rowley, superintendent—Milling and Grinding Machine Group; and W. G. Leonard, superintendent—Screw Machine Group, Brown & Sharpe Mfg. Co.



Why 242 different toolholders?

Metallurgical Products Department reports on an expanded new line of Lift-O-Matic toolholders . . . 242 sizes to speed changeovers on every job

Nobody needs to tell you what carbides have done for metalcutting . . . or how Carboloy® disposable inserts have led the way. *But making inserts is only half the job;* the other half is to provide you with toolholders that let you get full value from these miracle metals.

Carboloy Lift-O-Matic toolholders do this job. There are now three types—positive rake, negative rake, and tracer. All provide access to the clamp setscrew from either top or bottom—together with a self-raising chip-breaker clamp—for fastest possible indexing. All cut your inventory needs by providing interchangeability of parts. In addition, there is a full line of Carboloy *heavy-duty* toolholders.

This expanded Lift-O-Matic toolholder line is stocked by your *local* Authorized Carboloy Distributor—3 types, 9 styles, 242 sizes—*plus* the widest range of styles, sizes, and grades of *inserts* in the industry. Call him (see the Yellow Pages under "Carbides"); or write: *Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Road., Detroit 32, Michigan.*

CARBOLOY
CEMENTED CARBIDES

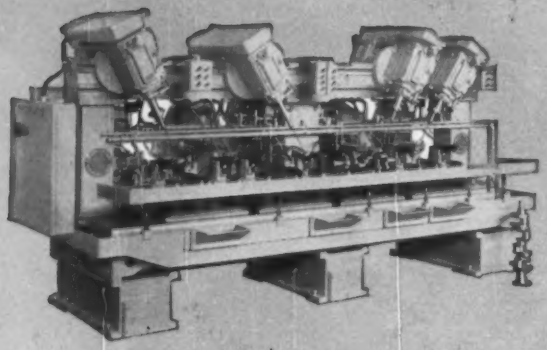
METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

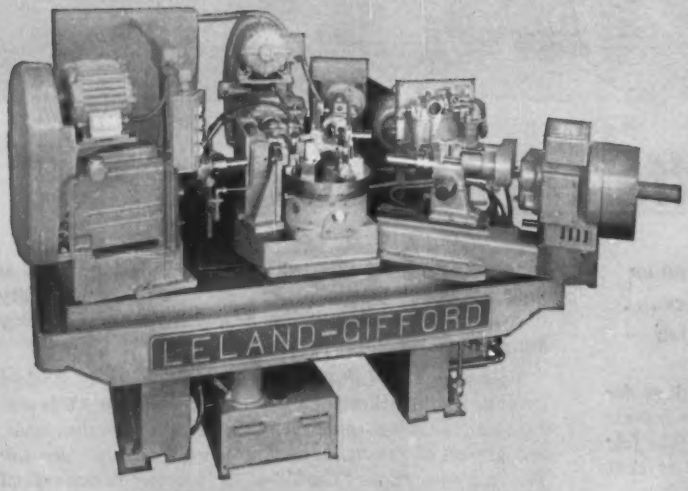
For more data, circle this page number on inquiry card

CRANKSHAFT OIL HOLE drilling machine. Four stations with self-contained units rail mounted for maximum flexibility of arrangement. Manually loaded with automatic clamping and release. Drills eight deep oil holes at 20 shafts per hour.

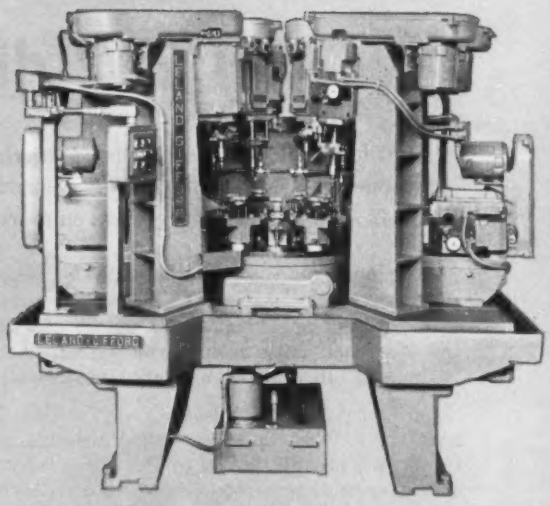


AIRCRAFT SPECIAL drills and reams 70 radial holes in a jet engine turbine case weldment at 3 pieces per hour. Insert shows tooling.

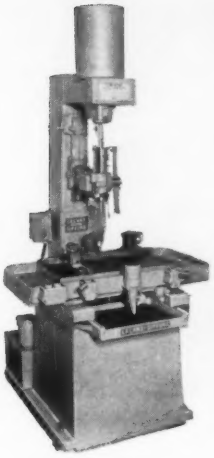
LELAND-GIFFORD



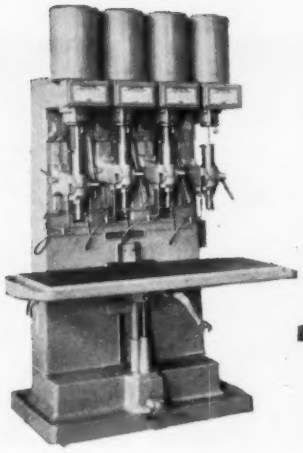
FUEL PUMP BODIES are drilled (27/64" x 1.54") and tapped (¼-18) two holes each at 240 pieces per hour. Four self-contained units operate around a three-station indexing fixture.



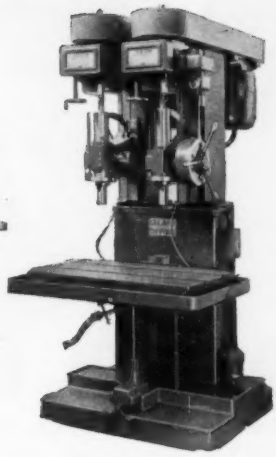
DIESEL INJECTOR PARTS. Six station "special" drills two holes 5/16" x 4 1/16" deep at 3° angle and two holes 9/64" x 1 3/8" deep at 20° angle. Interchangeable fixtures permit handling two different parts at 58 pieces per hour.



NEW HOLE LOCATOR for fast, accurate, jigless drilling with optical positioning from a simple, reusable layout chart.

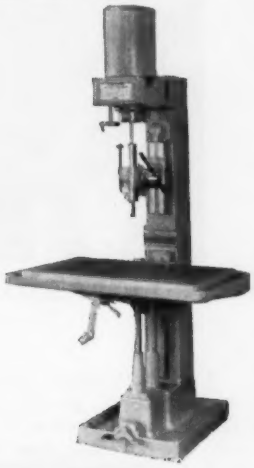


INDUSTRY'S STANDARD for precision drilling and tapping. No. 2LMS is available in one to six spindles; 20″ or 26″ swing; speeds up to 3600.RPM; hand, power or hydraulic feed.



FOR HEAVY DUTY DRILLING, No. 3MVB is available with eight speeds up to 1800 RPM; 24″ swing; one to four spindles; hand, power or hydraulic feed.

TOOLROOM DRILL PRESS. No. 2LMS has 26″ swing, oversize table, eight speeds, reversing motor for tapping. No. 3MVB with extra capacity also available.



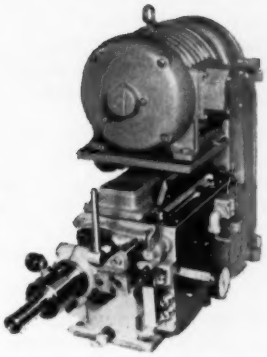
Drilling Machines

Representing more than 50 years of specialization in the manufacture of precision drilling equipment, the Leland-Gifford line includes:

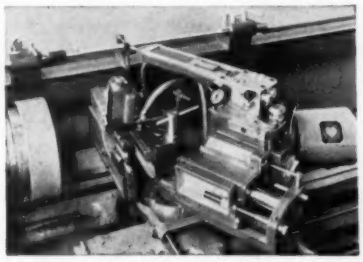
STANDARD sensitive and hydraulic feed machines in a complete range of types and sizes including the Leland-Gifford Hole Locator for jigless drilling with optical positioning.

SPECIAL machines incorporating Leland-Gifford drilling units, multiple heads, indexing tables, quick-handling fixtures and other high production features.

Bulletins give complete information. Write for them . . . or contact the office near you.



SELF-CONTAINED UNITS. Four sizes for holes from .020″ to 1.500″. Furnished with motor, hydraulic pump and accumulator system; dual feed, step x step or plain feed.



SINGLE UNIT HYDRAULIC LATHE TRACER ATTACHMENT Three sizes fit all standard or heavy duty lathes from 12″ to 25″ (up to 27½″ swing). Installed or removed in minutes. Does not limit utility of lathe.

LELAND-GIFFORD COMPANY • WORCESTER 1, MASSACHUSETTS

Branch Offices.. CHICAGO 5, 2515 W. Peterson Ave. • CLEVELAND 22, P. O. Box 853 • DETROIT 21, 10429 W. McNichols Rd. • INDIANAPOLIS 6, P. O. Box 1051 LOS ANGELES, 2620 Leonis Blvd., Vernon 58, Cal. • NEW YORK, 75 S. Orange Ave., South Orange, N. J. • ROCHESTER 12, P. O. Box 24, Charlotte Station,

(Left) H. H. Whitmore, executive vice-president, (center) J. C. Hebert, vice-president, and (right) R. S. Jones, general manager, Jones & Lamson Machine Co.

JONES & LAMSON MACHINE CO., Springfield, Vt., announced the election of H. H. WHITMORE as executive vice-president. Also elected was J. C. HEBERT as vice-president. R. S. JONES assumed the title of general manager.

BRYANT CHUCKING GRINDER CO., Springfield, Vt., announces that H. GLENN BIXBY was elected president following the resignation of former President J. H. Beardsley. The Bryant firm is a wholly owned subsidiary of Ex-Cell-O Corporation, Detroit, of which Mr. Bixby is president. N. A. LEYDS was elected vice-president and general manager.

MINIATURE PRECISION BEARINGS, INC., Keene, N. H., announces a new MPB Research Center, a building devoted principally to research and development, but also for new-products manufacturing in the precision metalworking field.

ALEXANDER HINDMARSH has been appointed sales representative for the MUELLER BRASS CO., Port Huron, Mich. Mr. Hindmarsh has been assigned to the Cambridge, Mass., office.

New York and New Jersey

AIRBORNE INSTRUMENTS LABORATORY Division of Cutler-Hammer, Inc., Mineola, N. Y., announces the purchase of the Fairchild Engine Division plant at Deer Park, L. I.

J. J. DALL has been appointed assistant general manager—Electric Welding, LINDE COMPANY, Division of Union Carbide Corporation, New York City.

CHARLES J. LAWSON, JR., was appointed director of manufacturing services for the INTERNATIONAL BUSINESS MACHINES CORPORATION, New York City.

ALEXANDER DALGLEISH has been appointed sales engineer for the eastern United States by K. R. WILSON., INC., Arcade, N. Y.

ALLOY TUBE DIVISION, Carpenter Steel Co., Union, N. J., announces three executive promotions. PAUL E. KELLY has been appointed manager of sales, SELDEN E. DOUGHTY, manager of technical services, and GRIFFIN M. STABLER has been appointed manager of production.

GENERAL ELECTRIC CO., Schenectady, N. Y., has opened a new manufacturing facility at Paterson, N. J., for the production of fractional-horsepower gear motors.

LESLIE F. SCHURCK has been appointed to the position of director of industrial engineering by Cooper Alloy Corporation, Hillside, N. J.

Ohio

EATON MFG. CO., Cleveland, Ohio, has absorbed the organization of GREGG & ASSOCIATES, formerly an independent sales agency which has been serving the company's Dynamatic Division in the New York Region for the last ten years. The company has also established a northeast sales region for Dynamatic products, consisting of New England, New York, Buffalo, Philadelphia, Pittsburgh, Washington, and the Richmond districts. W. E. GREGG, JR., head of Gregg & Associates, has been appointed northeast regional manager in charge of all the districts, and M. J. WOLOCK was named manager of the New York district. Assisting Mr. Wolock in the New York district office will be L. R. CAMPBELL, E. F. LOTT, and KARL D. CHAMBERS, as sales representatives.

PANGBORN CORPORATION, Hagerstown, Md., has announced the appointment of JAMES E. MARTIN as Cleveland district manager. Mr. Martin will direct over-all sales activities in field engineering services from the district headquarters at 9802 Euclid Ave., Cleveland, Ohio. He succeeds ROBERT E. DONNELLY, who retired after thirty years.

CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio, announces that P. WILLARD CRANE was elected vice-president. CINCINNATI MILLING AND GRINDING MACHINES, INC., (Cincinnati Milling's sales subsidiary) elected RICHARD A. DIDDAY vice-president.

RELIANCE DIVISION, Eaton Mfg. Co., Massillon, Ohio, announces the appointment of PAUL A. MILLER as general manager. Mr. Miller succeeds C. A. SELLEN who will become head of the division's expanded steel sales program.

WARNER & SWASEY CO., Cleveland, Ohio, announces plans for construction of a modern research center in Solon, Ohio. It will be dedicated in 1960 at the time of the company's eightieth anniversary.

JOHN W. DAUGHTERS has been appointed sales manager for the CINCINNATI GILBERT MACHINE TOOL CO., Cincinnati, Ohio.

Graham E. Marx, new president and general manager, G. A. Gray Co.

G. A. GRAY CO., Cincinnati, Ohio, announces that AUGUST MARX, in becoming chairman of the board, has relinquished his duties as chief executive officer to GRAHAM E. MARX, who has been elected president and general manager.

Pennsylvania

FIRTH STERLING, INC., Pittsburgh, Pa., has commenced construction of new melting facilities and a new building to house its newly acquired Hopkins (Kellogg) Process. The Hopkins Process is a technique for producing ultra-pure alloys by consumably re-melting electrodes of desired alloy composition by striking an arc through a purifying slag in a water-cooled copper crucible. JAMES L. LEWIS and R. K. HOPKINS, recently elected a vice president of Firth Sterling in charge of the specialty alloy steel operations formerly owned by the M. W. Kellogg Co., were elected to the board of directors.

FISCHER MACHINE CO., Philadelphia, Pa., announces that WILLIAM F. FISCHER, JR., has succeeded his father as president of that company and its subsidiary, Scriptomatic, Inc. HERBERT W. LEONARD was elected to the position of vice-president of Scriptomatic, Inc. The following were elected as directors of both companies: DONALD C. RUBEL, J. BARCLAY JONES, and HERBERT W. LEONARD.

The Altoona, Pa., plant of SKF INDUSTRIES, INC., broke ground in ceremonies launching a 4.5 million dollar expansion program to be completed by the end of 1959.

STANDARD PRESSED STEEL CO., Jenkintown, Pa., announces that CHARLES J. BETZ has been named manager of outside sales of industrial fasteners. DONALD J. MORRIS succeeds Mr. Betz as inside sales manager for this line.

HOLTON E. FOX was appointed to the post of district manager, Philadelphia District Sales Office, SKF INDUSTRIES, INC., Philadelphia, Pa. Mr. Fox fills a vacancy created by the appointment of HAROLD W. SPEIDEL to the newly created position of manager, sales product planning.

GEORGE A. SCHRIBER has been named manager of sales—Pittsburgh district, for JESSOP STEEL CO., Washington, Pa.

Tennessee, Georgia, and Florida

METALLURGICAL PRODUCTS DEPARTMENT, General Electric Co., Detroit, Mich., announces the appointment of the E. C. BLACKSTONE CO., 600 Madison Ave., Memphis, Tenn., as an authorized distributor of Carboloy cemented carbide products. Blackstone Co. service engineers are active in Tennessee, Mississippi, Arkansas, Alabama, and Missouri.

TORRINGTON CO., Torrington, Conn., announces the opening of a district office in Atlanta, Ga., as another step in the field expansion of its Bearing Divisions at Torrington and South Bend, Ind. LARRY PAINE, district engineer, will serve the states of North Carolina, South Carolina, Georgia, Florida, Alabama, and Tennessee. Offices will be at 244-246 Walker St. S.W., Atlanta, Ga.

DANIEL BAUGH has been appointed sales engineer of the CAPEWELL MFG. CO., Hartford, Conn. Mr. Baugh's territory will include Florida, parts of Georgia, Alabama, and the Carolinas. He will reside in Clearwater, Fla.

Wisconsin

CUTLER-HAMMER INC., Milwaukee, Wis., announces the appointments of P. B. HARWOOD as a senior vice-president and E. B. FITZGERALD as vice-president in charge of engineering.

RACINE HYDRAULICS & MACHINERY, INC., Racine, Wis., announces that JOHN E. ERSKINE has been elected president, succeeding his father, MALCOLM E. ERSKINE, who continues as chairman of the board. GEORGE B. MILLER was named executive vice-president. JAMES E. MOHRHAUSER was made vice-president in charge of operations.

HOWARD R. HAMMOND will be general manager of the newly created Defense Products Division, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

AC SPARK PLUG DIVISION, General Motors Corporation, Milwaukee, Wis., announced that FRANK CURTHBERTSON was promoted to director of production engineering and HOWARD FISH was promoted to manufacturing manager.

Coming Event

Week of July 27—National Machine Tool Builders' Association, 2071 E. 102nd St., Cleveland, Ohio. Annual Sales Conference to be held at Cornell University, Ithaca, N. Y.

SEPT. 28-Oct. 1—American Welding Society Fall Meeting to be held in the Sheraton-Cadillac Hotel, Detroit. AWS headquarters are at 33 W. 39th St., New York 18, N. Y.

NOVEMBER 2-6—Forty-First National Metal Exposition and Congress to be held at the International Amphitheatre, Chicago, Ill. It is under the management of the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; Chester L. Wells, director.

• • •

Boring-Head Design

A new color-sound strip film on the design, construction, and application of high-precision boring heads has been released by the Briney Mfg. Co. Boring heads designed around the company's patented principle can be adjusted in increments smaller than 0.0001 inch without loosening or tightening any screws.

The film runs for eleven minutes and is suitable for showing to any size technical group interested in new tooling methods and applications. It can also be adapted to training machine operators in the proper use and maintenance of their tools. Arrangements for showing the film can be made through any Briney representative or by direct inquiry to the factory at 1165 Seba Road, Pontiac, Mich.

Obituaries

John C. Lincoln

JOHN C. LINCOLN, ex-chairman of the board, and ALTON F. (Charlie) DAVIS, vice-president and secretary, LINCOLN ELECTRIC CO., Cleveland, Ohio, succumbed within twenty-four hours of each other in May. Mr. Lincoln, aged ninety-two, founded the company in 1893, and was president until 1928, when he became chairman of the board, a post now held by his younger brother, James F. Mr. Lincoln developed many of the company's products and had been issued more than fifty patents for electrical devices including one for a variable-speed motor. He had extensive realty holdings and charitable interests.

Mr. Davis, aged sixty-nine, started in a service and sales capacity, and later switched to public relations and advertising. His long career with the company was exceeded only by that of the two Lincoln brothers. In 1925, Mr. Davis became a director and vice-president, and in 1938, secretary. When the James F. Lincoln Arc Welding Foundation was created in 1936, he was appointed its secretary. A member of many professional and fraternal organizations, he established the most extensive welding library in the world at Ohio State University in 1942.

Alton F. Davis

ELMER ELLSTROM, SR., founder of DEARBORN GAGE CO., Dearborn, Mich., died in May at the age of seventy-two. He had a long and fruitful career in the metalworking industry. Although nominally retired since 1953, he remained active in the affairs of the company he founded until his death.

JAMES C. MABE, vice-president in charge of plant operations for the CHICAGO PNEUMATIC TOOL CO., New York City, and a member of the board of directors, died recently. He was forty-one.

HERBERT W. HANSEN, eastern sales manager, the PRODUCTO MACHINE CO., Bridgeport, Conn., died in April. He was fifty-four.

New Books and Publications

DESIGN OF AIR-CONDITIONING SYSTEMS. By F. W. Hutchinson. 336 pages, 6 by 9 inches, 115 working charts and graphs, tables, and data. Published by The Industrial Press, 93 Worth St., New York 13, N. Y. Price, $7.

The major intent of Professor Hutchinson's new book is to provide methods for simple and effective utilization of organized, useful knowledge. Subject matter has been carefully selected and emphasis has been placed on methods of complementing the handbook data readily available in standard sources.

Special features of this book include: (1) Data for determination of inside thermal levels; (2) complete data on solar irradiation rates; (3) A group of graphical solutions determining the required temperature of conditioned air supply; and (4) A special chapter on the design of panel cooling systems.

An important feature of the book is the provision of full-page graphical solutions of the most important equations in each chapter.

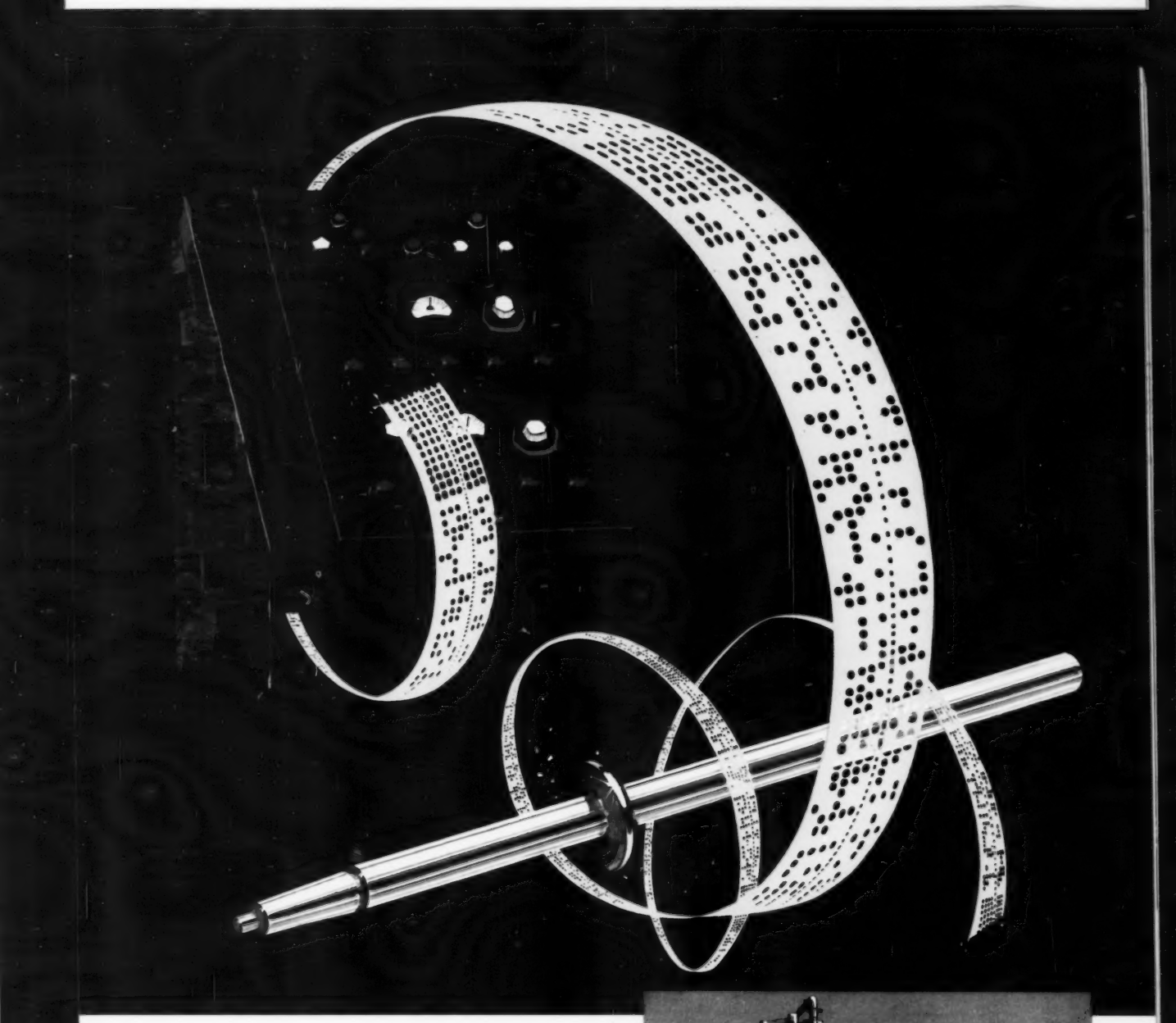
AMERICAN STANDARD—KNURLING. ASA B5.30-1958. 15 pages; 8 1/2 by 11 inches; illustrated. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, $1.50.

A revision of American Standard B5.30—Knurling—has been approved by the American Standards Association. It is one of a series of standards for small tools and machine tool elements. Tooth depths for diagonal knurls have been added, and various editorial changes have been made in the revision for the sake of clarity.

The standard covers knurling tools with standardized diametral pitches. It includes dimensional relations with stock in the production of straight, diagonal, and diamond knurling on cylindrical surfaces which have teeth of uniform pitch parallel to the axis of the cylinder or at a helix angle not exceeding 45 degrees with the axis of work. The tools and applications covered in the standard are applicable to both general-purpose and precision knurling. An advantage of the standardized method is the provision by which good tracking is obtained by tools designed on the basis of diametral pitch instead of TPI (teeth per inch) when used with recommended work blank diameters that are multiples of 1/64 or 1/32 inch, depending on the pitch selected.

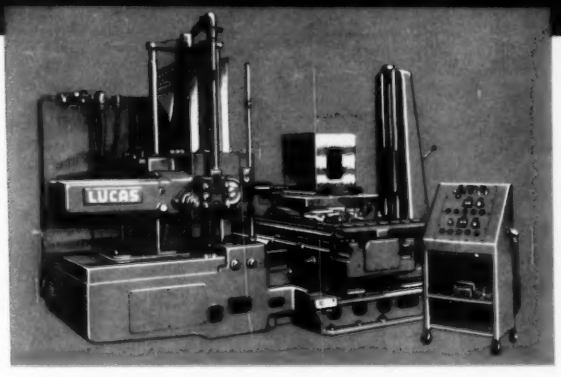
AMERICAN STANDARD FOR DIAMOND DRESSING TOOLS. B67.1-1958. Sponsored jointly by ASTE and Industrial Diamond Association of America. 8 1/2 by 11 inches; illustrated. Published by American Standards Association, 70 E. 45th St., New York 17, N. Y. Price, $1.

This approved American Standard for Diamond Dressing Tools (B67.1-1958) establishes standard shank dimensions of diamond tools used for dressing or truing grinding wheels. Tools requiring special-shaped diamonds are not specifically covered by the standard, but in many applications they are expected to conform to it. The tools listed are expected to apply to offhand wheel-dressing operations as well as to automatic wheel-dressing attachments for machine tools, including fixtures that mechanically turn the diamond tool during its work cycle.

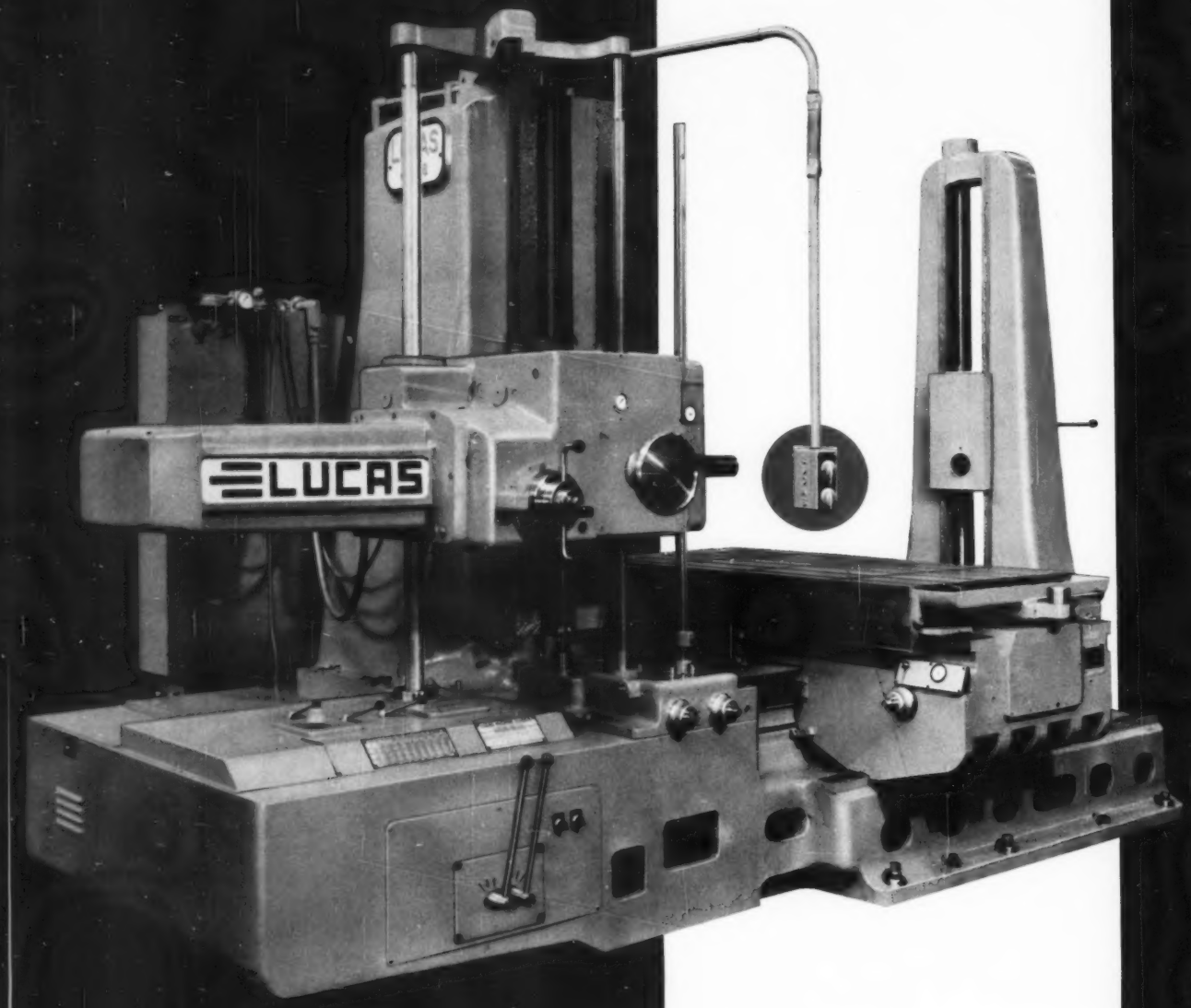


Tape control... certainly!

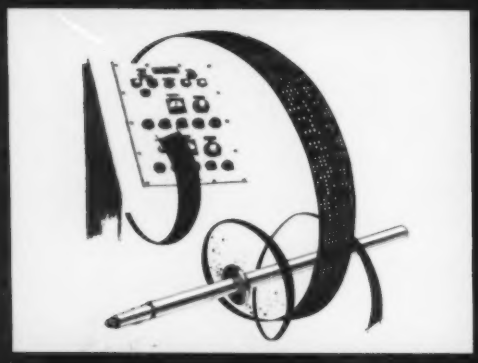
Tape control can readily be applied to any Lucas model, (2 3/4″ to 6″ diameter spindles) if repetitive operations or complicated one-of-a-kind jobs make this new development advantageous. Lucas tape controlled machines are available with punched tape for N.P.C., magnetic tape for contouring, or tape and tracer control. If you have a profitable use for *any* type or size of horizontal boring, drilling and milling machine (up to 6″ spindle capacity) you can get it at its best from the specialist in this type of machine. *Did you ever meet a man who regretted picking a Lucas?*



LUCAS
OF CLEVELAND



Simplified pendant controls . . .



A Lucas performs the greatest variety of operations possible in any machine tool. Standard models permit control of *all* operations from the pendant. Optional pendant and lever control machines, like the one shown above, combine a simplified pendant with readily accessible levers. Whichever type of control you want—pendant, lever, tape, tracer or any of these in combination —Lucas has it.

LUCAS
OF CLEVELAND

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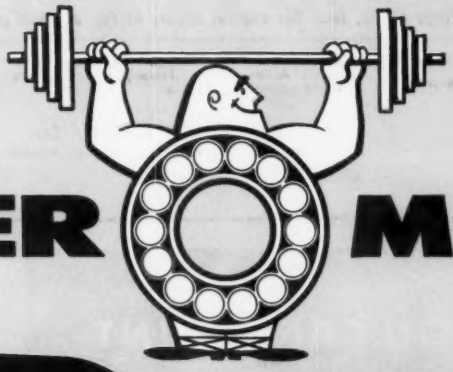
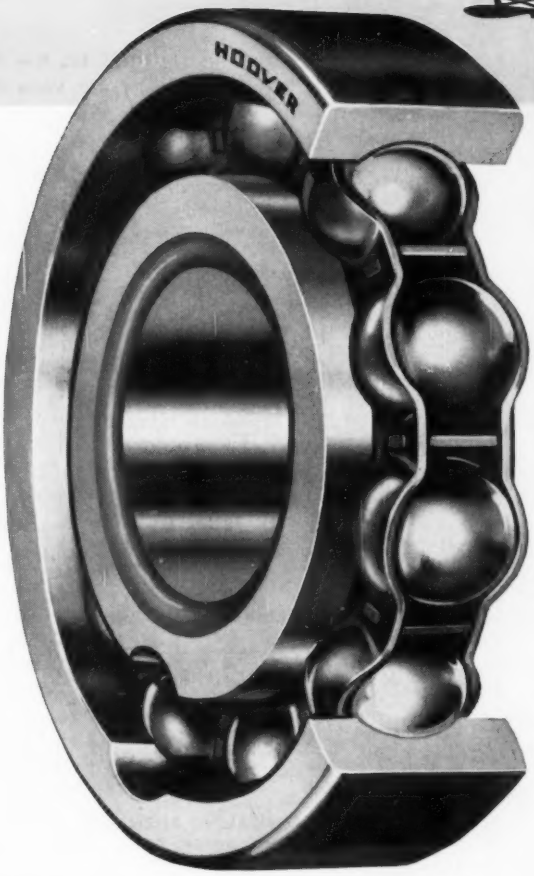


"SUPER MAX"



Maximum Capacity Ball Bearings of Outstanding Quality

Hoover has designed "Super Max" bearings to provide the greatest radial capacity that can be efficiently obtained in a single row ball bearing. These durable bearings utilize the maximum number of extra-large-size balls that can be introduced into the bearing, giving optimum load-carrying ability. In addition, the smoothness of *Hoover Honed* raceways and the perfect matching of *Micro-Velvet* balls, accurate within millionths of an inch, contribute to exceptional load-carrying capacity.

Hoover "Super Max" bearings are recommended for applications requiring extended life under relatively heavy radial loads. They are available in open and shielded types, with or without snap ring, to meet maximum capacity requirements.

Hoover Honed, *Micro-Velvet* and "*Super Max*" are Hoover trademarks.

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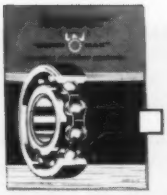

FREE LITERATURE

Check the information you want.

☐ BULLETIN 107 gives complete data on "Super Max" bearings.

☐ HOOVER HANDI-BOOK of Anti-Friction Bearings outlines bearing types, problems, applications.

Hoover Ball and Bearing Company M-7
5400 South State Road, Ann Arbor, Michigan

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Title_____

Company_____

Address_____

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For more data, circle this page number on inquiry card

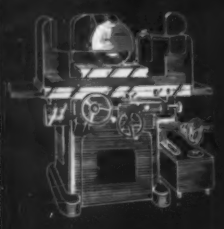
Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

ABRASIVE CLOTH, Paper and Belt
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

ABRASIVES, Disc
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Norton Co., 1 New Bond St., Worcester, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.

ABRASIVES, Polishing, Tumbling, Etc.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Macklin Co., Jackson, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia, 35, Penna.



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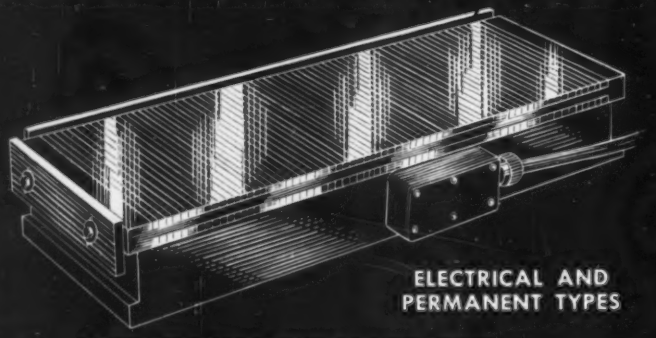

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Users know – and machine builders, too – a Magna-Lock chuck is a "natural" for a fine machine tool. When you order your new machine, specify it equipped with a Magna-Lock chuck – leading machine tool builders recommend and furnish Magna-Lock. Want details? Write today, Dept. MH59.

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Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

AIR GAGES, Dimensional—See Gages Air Comparator

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Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

ALLOY STEELS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Jessop Steel Co., Washington, Penna.
Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave. Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio.
Carpenter Steel Co., 105 W. Bern St., Reading Penna.
Mueller Brass Co., Port Huron, Mich.

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Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
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ANGLE PLATES—See Set-up Equipment

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ARBOR PRESSES—See Presses Arbor

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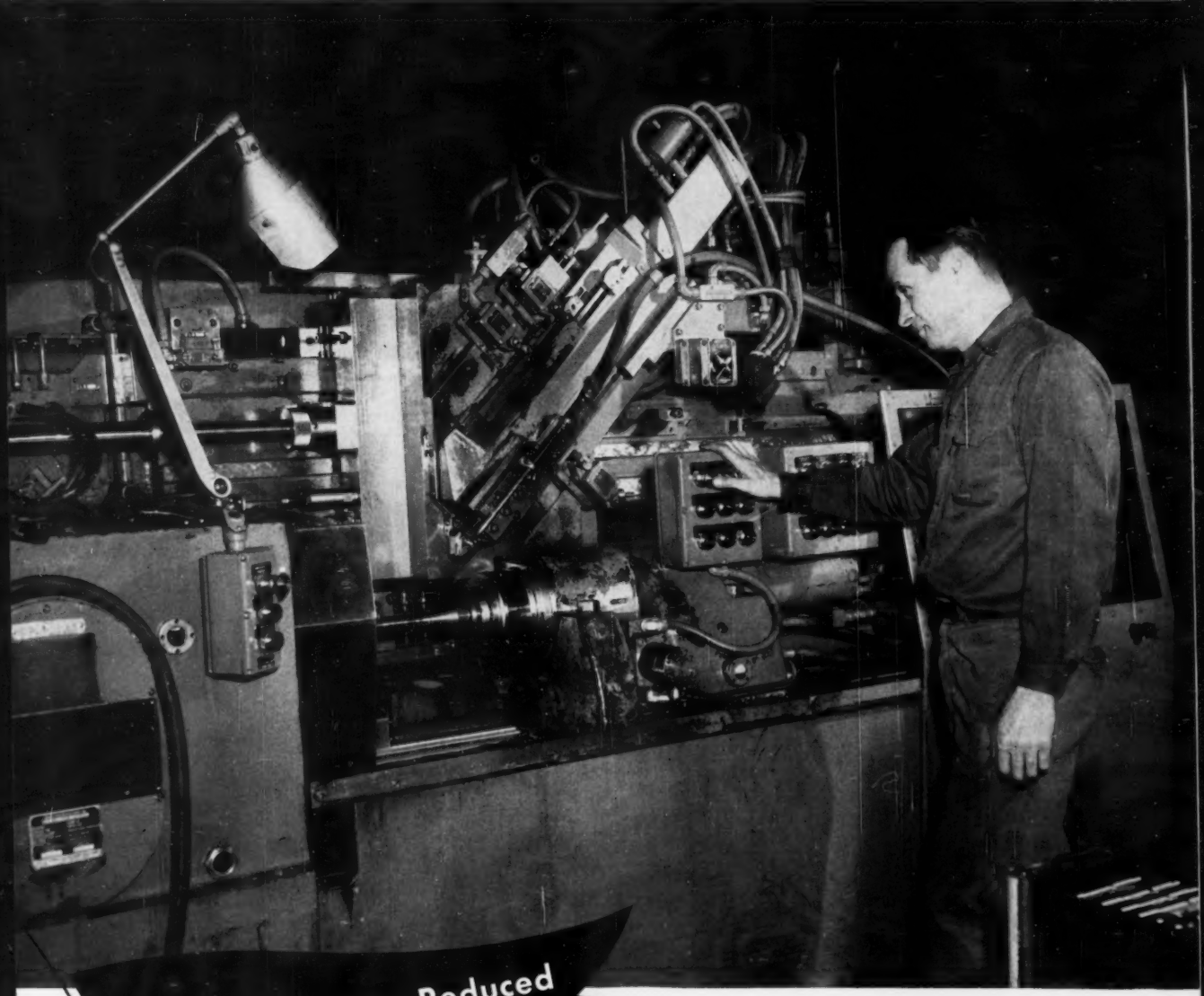
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mich. Co., Inc., Logansport, Ind.



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Further, they are completely satisfied with the Bullard Hydra-Feed and, if ordering another machine for the same job, would consider purchasing another Bullard Hydra-Feed Lathe.

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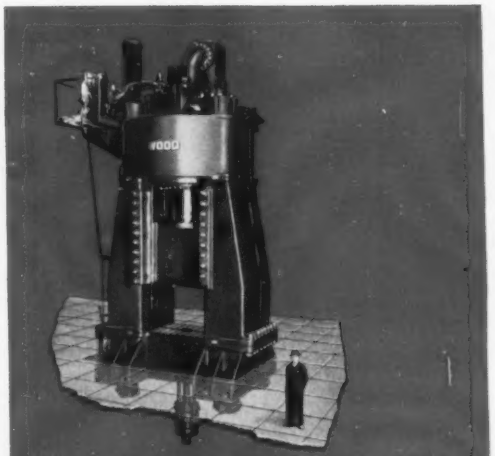
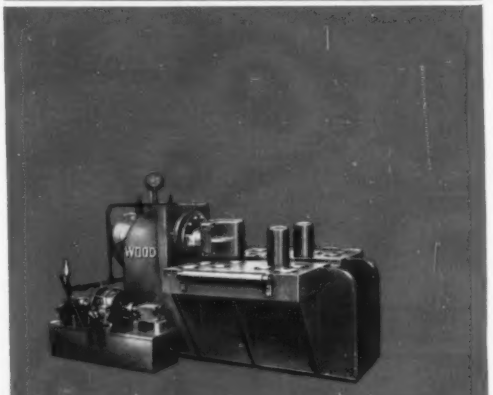
Plan for tomorrow's needs, today!

An R. D. Wood Press can be the key to better production capacity needed today . . . and equally efficient capacity in a growing economy in the years to come. In terms of today, you replace worn out equipment, increase production rates and cut excessive downtime. For the long pull, you are in a position to produce top quality products with top operating efficiency and stay on top of heavier production schedules with equipment that can still deliver . . . day, after day, after day.

Check the stamina story of R. D. Wood Presses, today. The long-range sure economy, too. Write for information on the type of press or presses that you require.



For Forging and Cogging Operations—Machine Number 8439, down-working hydraulic press. Capacity, 3,000 tons; platen size, 4'0"x5'0"; ejector ram, 51 tons; stroke of main ram, 3'0"; height of press, 31'11"; floor space, 9'6"x13'1".

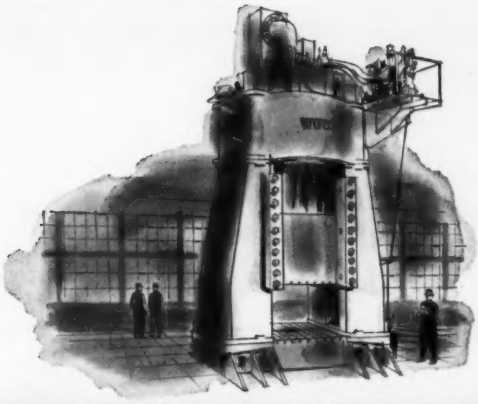


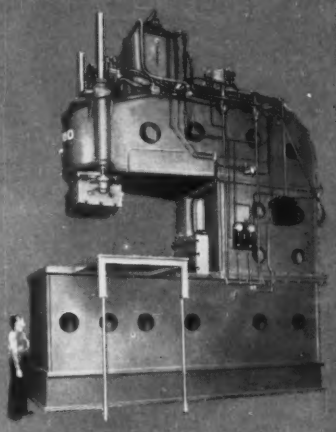
For Bending and Straightening Operations—Machine Number 8441, complete with integral pumping system. Capacity, 200 tons; stroke, 12"; table size, 4'4" x 6'0".

The presses illustrated here are representative of the complete line of hydraulic presses and valves produced by R. D. Wood Company. All of those shown are available in various capacities and others are available for different operations. Write to R. D. Wood Company for recommendations on the press to suit your specific problem.

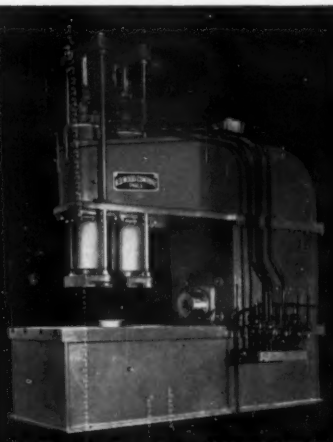
R. D. WOOD COMPANY
PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA

LOOK!

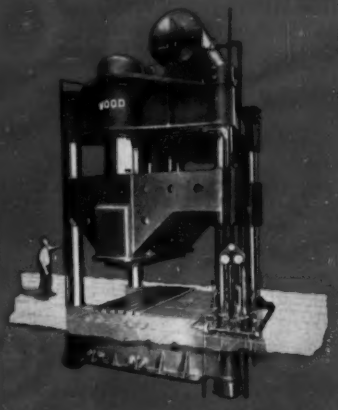




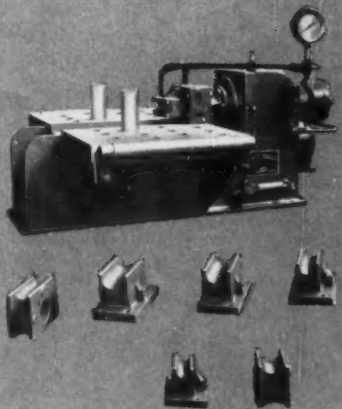
For Straightening Operations—Machine Number 8775, HydroLectric open-gap press. Capacity, vertical ram, 750 tons, horizontal ram, 400 tons; gap, 7'0"; vertical daylight, 4'6"; height of press, 26'5"; floor space, 21'10" x 20'0".



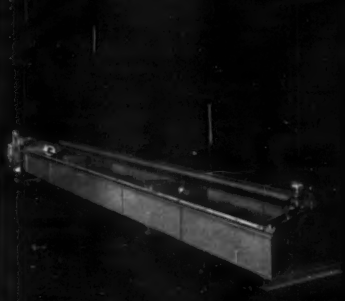
For Flanging Operations—Machine Number 8487, sectional hydraulic flanging press—also for joggling and upsetting operations. Capacity with vertical rams in unison, 300 tons; horizontal ram, 115 tons; stripper ram (in bed), 115 tons; gap, 5'0"; vertical daylight, 3'9"; height of press, 15'9", floor space, 5'0"x14'2".



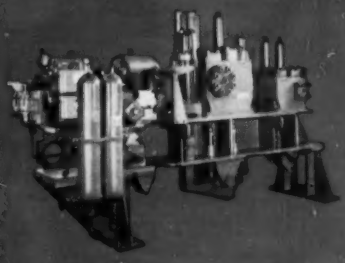
For Bending and Forming Operations—Machine Number 8548, hydraulic press. Capacity, 1,500 tons; moving platen size, 1'10" x14'2"; ram stroke, adjustable, 4'0"; height of press, 29'; floor space, 16'0"x15'6".



For Pipe Bending Operations—Machine Number 9089, horizontal cold-bending press, complete with self-contained pumping system. Capacity, 25 tons; stroke of ram, 11"; table size, 2'8½"x4'2".



For Tube Testing Operations—Machine Number 9284, hydrostatic tube testing machine. Capacity, 4½" to 12" OD tubes, maximum tube length, 35'; test pressure, 700 to 1,500 psi; average production (12" tubes, 35' long), 30 per hour; floor space required, 5'0"x45'0".



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Assures Controlled Finish . . .
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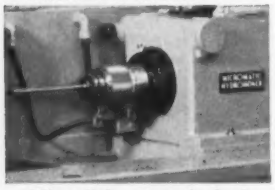
Basic "150" Hydrohoner —delivered from stock.

Microsize gage automatically ends cycle when exact size is reached.



Microdial automatic feed control and stone wear compensation.

Possessing a 12-inch stroke and a work diameter capacity of 1½ inches, the standardized "150" readily accommodates a variety of fixturing and tooling to assure easy adaption to a wide variety of work parts. Also, by addition of standard packaged units produced by Micromatic, it can be partially or fully automated.

Performing to the standards of higher-priced, special-purpose honing machines and incorporating features of a general-purpose design, the "150" Hydrohoner is an economical, long-range investment for long or short production runs.

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Sheffield Corp., Box 893, Dayton 1, Ohio

AUTOMATIC SCREW MACHINES—See Screw Machines, Single and Multiple-Spindle Automatic

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Oakite Products, Inc., 26 Rector St., New York 6, N. Y.

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DoAll Co., Des Plaines, Ill.
Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

BALLS
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Kennametal, Inc., Latrobe, Penna.

BAR MACHINES—See Screw Machines, Single and Multiple-Spindle, Automatic

BAR STOCK, Non-ferrous
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Shenango Furnace Co., Dover, Ohio

BAR STOCK AND SHAFTING, Steel
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Jessop Steel Co., Washington, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARING PILLOW BLOCKS AND CARTRIDGES
Fafnir Bearing Co., New Britain, Conn.

BEARINGS, Ball
Ball & Roller Bearing Co., Danbury, Conn.
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Japan Bearing Export Co., Ltd., Tokyo, Japan
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
S K F Industries, Inc., Philadelphia, Penna.

BEARINGS, Bronze and Special Alloy
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio

BEARINGS, Oilless
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARINGS, Roller
Ball & Roller Bearing Co., Danbury, Conn.
International Ball & Roller Bearing Corp., 3123 Eastlake, Seattle 2, Wash.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Rollway Bearing Co., Inc., 541 Seymour St., Syracuse, N. Y.
S K F Industries, Inc. Philadelphia, Penna.
Sonnet Tool & Mfg. Co., Hawthorne, Calif. (Milling Machine, arbor)
Timken Roller Bearing Co., Canton, Ohio

BEARINGS, Thrust
Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Fafnir Bearing Co., New Britain, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., Nicetown, Philadelphia, Pa.
Rollway Bearing Co., Inc., Syracuse, N. Y.
S K F Industries, Inc., Philadelphia, Penna.
Timken Roller Bearing Co., Canton, Ohio.

BELTING, Transmission
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.

BELT SANDERS—See Grinding Machines, Abrasive Belt

BENCH CENTERS
Brown & Sharpe Mfg. Co., Providence, R. I.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BENDERS, Bar, Tube, Channel, etc.
Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BENDERS, Plate, Etc.
Cincinnati Shaper Co., P.O. Box 111, Cincinnati 11, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BENDING MACHINES, Hydraulic
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Hydraulic Press Mfg. Co., Mount Gilead Ohio.
Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDING MACHINES, Pipe
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Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDING ROLLS
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BLAST CLEANING EQUIPMENT
Pangborn Corp., Hagerstown, Md.

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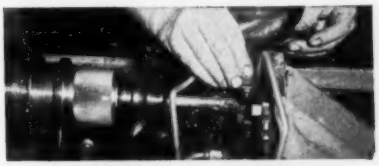
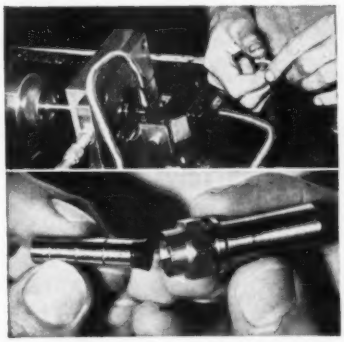
HOW Manufacturers Use "150" HYDROHONER To Reduce Costs...Control Finish... Obtain Rapid Stock Removal

Leading Manufacturers of precision parts are using the low-cost "150" Hydrohoner to secure high production, rapid stock removal, geometrical precision and controlled surface finishes. Indicative of the versatility for application of this highly efficient honing machine are the following recent installations:



The crankpin bore of a compressor connecting rod is Microhoned on a "150" Hydrohoner within tolerances of .00015" for taper, and .0002" for size and out-of-roundness. From .0008" to .001" of stock is removed from the bore (.875" diameter x .43" long) in about 8 seconds, while obtaining an 8 Microinch finish.



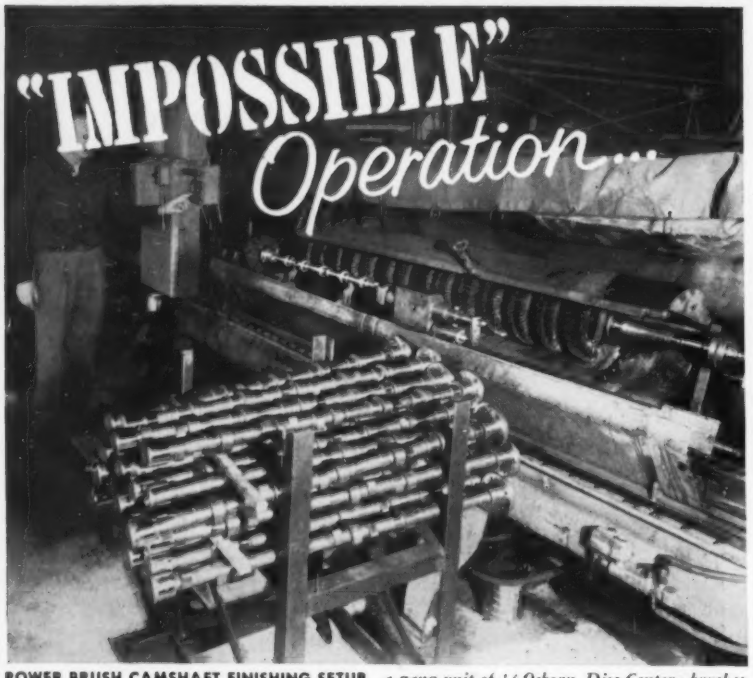
In this installation, a "150" is Microhoning in two runs the bore (.313" diameter x 1.375" long) of a braking cylinder. The first run removes between .004" and .006" of stock in 30 to 35 seconds. During finishing run, the final .0005" to .0008" is removed to provide geometric accuracy within .0002" tolerance and an 8 Microinch or better finish. Precision and controlled finish of bore prevent hydraulic oil leakage and minimize wear of neoprene-cupped piston.

The principles and application of Microhoning are explained in a 30-minute, 16mm, sound movie, "Progress in Precision" . . . available at your request.

☐ Please send me "Progress in Precision" in time for showing on _____(date).
☐ Please have a Micromatic Field Engineer call.
☐ Please send Microhoning literature and case histories.

NAME _____
TITLE _____
COMPANY _____
STREET _____
CITY _____ ZONE _____ STATE _____ J

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN



POWER BRUSH CAMSHAFT FINISHING SETUP *was designed and built by Universal Camshaft Co., Muskegon Heights, Michigan. It incorporates lathe bed, air cylinder, 50 hp motor and a gang-unit of 14 Osborn Disc-Center® brushes. Operation deburrs cams and cleans plating chips from steel shafts automatically.*

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This manufacturer had been finishing steel camshafts by a slow, costly off-hand method that resulted in pitted shafts and inconsistent deburring . . . high scrap loss. It looked like an "impossible" operation to improve.

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Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

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Northwestern Tools, Inc., 115 Hollier Ave., Dayton 3, Ohio.
Orban Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Trans National Fabricators Corp. (T.N.F.), 1052 E. Elizabeth Avenue, Linden, N. J.
Williams, J. H. & Co., 400 Vulcan St., Buffalo, 7, N. Y.

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DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kennametal Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 327, Roosevelt Park Annex, Detroit 32, Mich.
Universal Engineering Co., Frankenmuth 2, Mich.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
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Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
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Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.
Universal Engineering Co., Frankenmuth 2, Mich.
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Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 24th St., Milwaukee 10, Wis.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Drillmation Co., Inc., Centerline, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
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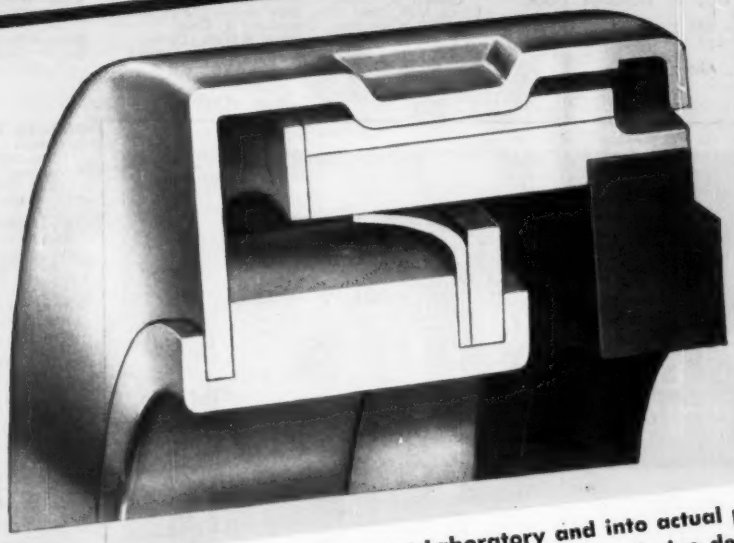
(*Continued on page 252*)

NEW *Only Gits Met-L-Seal** Seals at -65° to +850° F.



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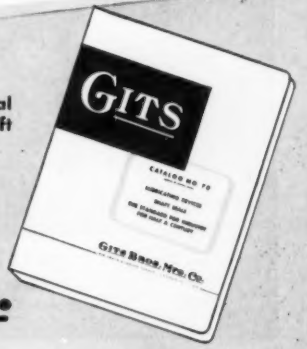
4 No "shelf life" problems. No "cure-date" limitations as are necessary with synthetic-elastomer seals.



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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
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Cosa Corp, 405 Lexington Ave., New York 17, N. Y.
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Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
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Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
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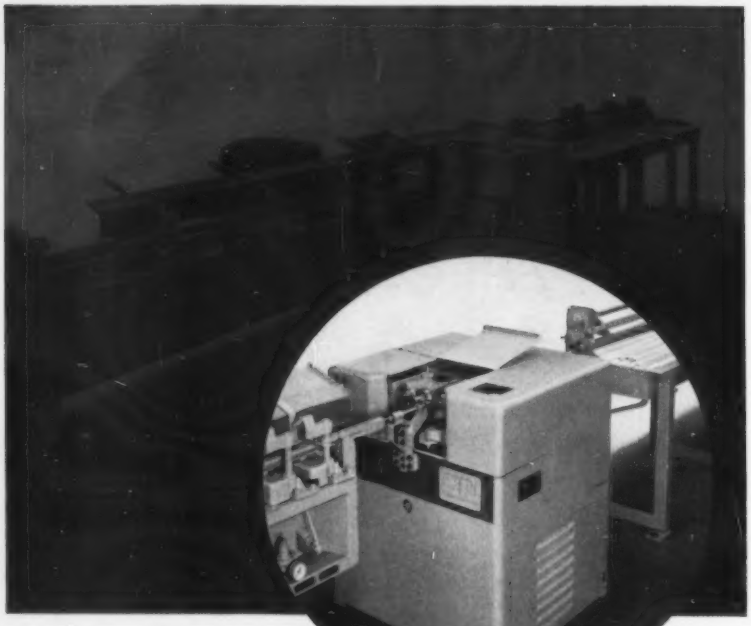
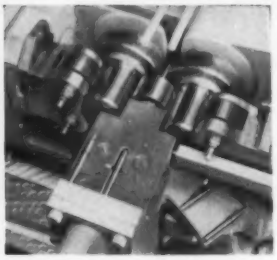


Thru-Feed Rolling— Fully Automatic

Model B-111

.... for Production or Job lot Threading and Form Rolling



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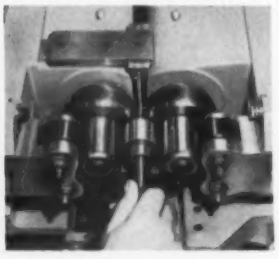

In-Feed Rolling— Manual loading

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BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

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Metal Corbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

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Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
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Universal Engrg. Co., Frankenmuth, Mich.

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CALIPERS, Vernier
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DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S. Co., Athol, Mass.

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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

CAMERAS, High Speed
Wollensak Optical Co., Rochester 21, N. Y.

CAM MILLING AND GRINDING MACHINES
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Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
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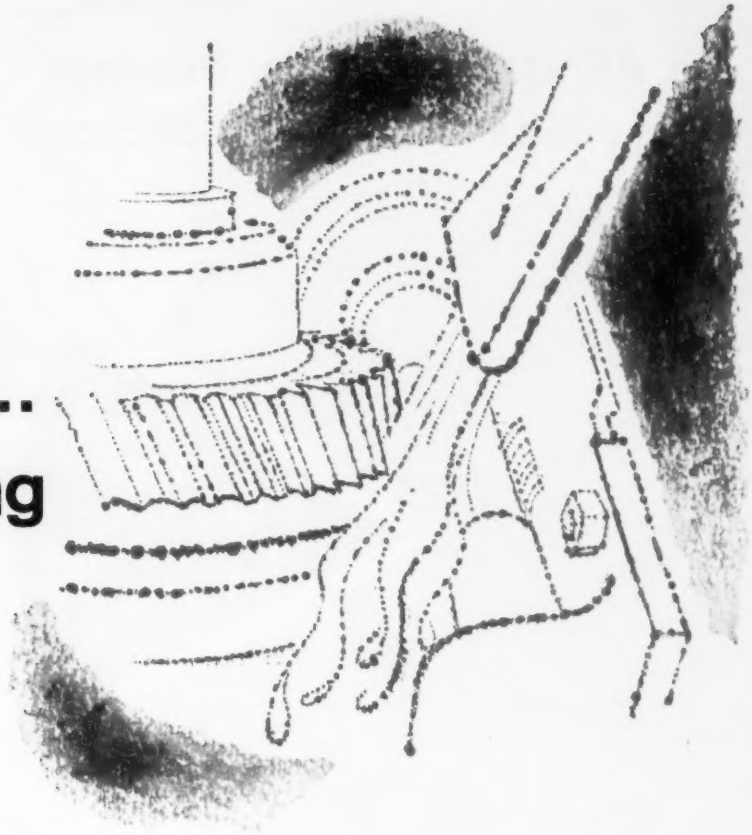

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Manufactured in Japan in one of the world's most modern bearing plants, International KOYO bearings are an outstanding example of American and Japanese teamwork. Millions of dollars in precision American machine tools are used in their manufacture. In addition, 95% of the iron ore used in the bearing steel is a product of the U. S.

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GENERAL OFFICES: 3123 Eastlake, Seattle 2, Washington

CARBIDES
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Shenango Furnace Co., Dover, Ohio.
Textile Machine Works, Reading, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Malleable Castings Council, 1800 Union Commerce Bldg., Cleveland 14, Ohio.
Shenango Furnace Co., Dover, Ohio.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Textile Machine Works, Reading, Penna.

CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Jessop Steel Co., Washington, Penna.

CENTER-DRILLING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

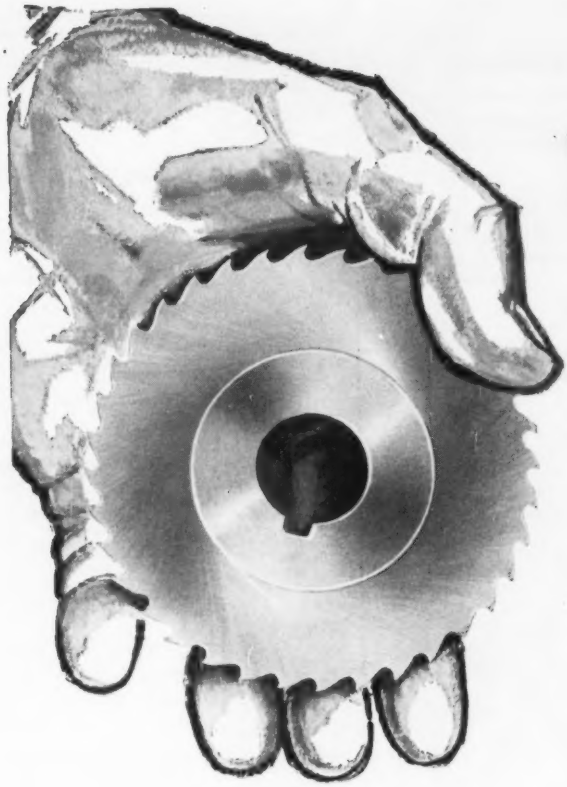
CENTERS, Grinding Machines, Indexing Head and Lathe
DoAll Co., Des Plaines, Ill.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

CHUCKING MACHINES, Multiple-Spindle Automatic
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.

(*Continued on page 258*)



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Olofsson Corp., 2729 Lyons Ave., Lansing, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKING MACHINES, Single-Spindle Automatic
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter & Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

CHUCKS, Air Operated
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

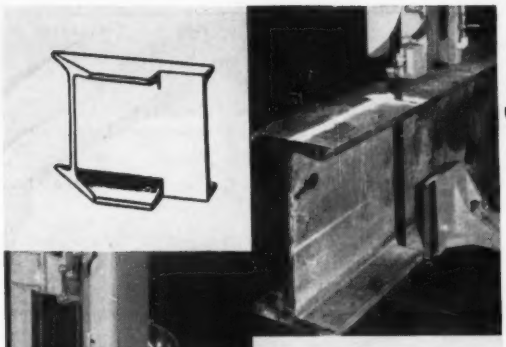
CHUCKS, Combination Universal-Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison, 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Diaphragm
Woodworth, N. A. Co., 1300 E. Nine Mile Rd., Detroit 20, Mich.

CHUCKS, Drill, Key Type
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Drill, Keyless
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37 N. Y.
Jacobs Mfg. Co., West Hartford, Conn.

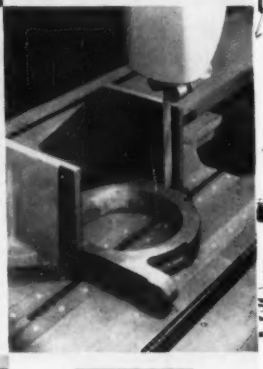


COPING AND MITERING HEAVY STRUCTURAL SHAPE

18" Beam (above) is held between vises for the short cut. On the long cut (left) vises were removed and beam held by simple clamp. The MARVEL Band Saw is truly indispensable in ornamental and structural iron shops where this type of work is done daily. The machine will cut-off square, miter and cope any work shape from the smallest moulding to 18" I-beams.

SPLITTING CLAMP RINGS, BUSHINGS

Splitting clamp rings, connecting rods, bushings and collets is a fast, simple operation on the No. 8 Band Saw. Perfect control, quick chucking facilities, accuracy and speed are features that especially fit the machine to handle this type of work.

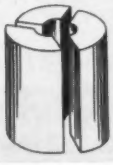


MITERING LARGE DIAMETER PIPE

Pipe (or any bar shape) may be mitered at a 45° angle without the need for special jigs or fixtures. Even when cutting miters, work remains in the same position as it does for straight cuts. Column and blade are instantly tilted to desired angle, even without stopping the machine. Perfect miters (or lesser angles) are sawed without any layout or special equipment.

SEGMENTING LARGE DIE BLOCK

Three equally spaced re-entrant cuts were made in this 16" x 18" SAE 4130 Forging. Job was completed, floor-to-floor in 5 hours. No special jigs or fixtures were required. An unusual job that serves to emphasize the versatility of the MARVEL No. 8 Saw.



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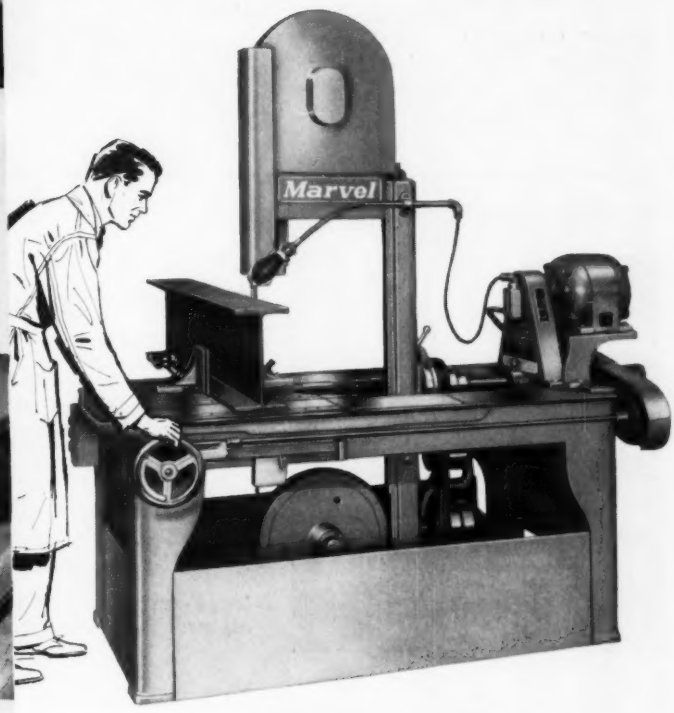

"As simple to use and handy as a Scout Knife" is the way another user described his MARVEL No. 8 Universal Band Saw recently . . . and we can't think of a better way to describe this versatile metal cutting machine.

With a MARVEL No. 8 Band Saw, you can do almost any conceivable straight, angle, or miter metal sawing job—from cutting-off bar stock to making the most unusual forming cuts. You can handle small, delicate work, and in the next minute, saw structurals, or segment large work as illustrated in the lower photograph. You will save time, labor, and material with a MARVEL No. 8 Band Saw because no other saw has all the features to be had in this truly universal tool.

Upright column design and forward travel of the blade through the work (which remains stationary on the table-height saw bed) provides easy, unobstructed visibility and more convenient and efficient working conditions; column can be tilted and locked at any angle up to 45° left and right of vertical; the exclusive MARVEL Power Feed with Automatic Overload Relief; Automatic cutting-depth stops; simple, convenient operating controls—these are some of the features which make the No. 8 Band Saw the most useful—and used—metal cutting saw on the market.

For the complete story, ask or write for Bulletin 875 which illustrates and describes MARVEL Universal Metal Cutting Band Saws.

MARVEL Metal Cutting SAWS
Better Machines-Better Blades

ARMSTRONG-BLUM MFG. CO. 5700 N. BLOOMINGDALE AVE. • CHICAGO 39, ILL.

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CHUCKS, Full Floating
Gisholt Mch. Co., Madison 10, Wis.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear
Buck Tool Co., 2015 Schippers Lane, Kalamazoo Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.

CHUCKS, Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, etc.
Bullard Co., Brewster St., Bridgeport 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Magnetic
Brown & Sharpe Mfg. Co., Providence, R. I.
Hanchett Magna-Lock Corp., Big Rapids, Mich.
L-W Chuck Co., Toledo 4, Ohio.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Walker, O. S. Inc., Worcester, Mass.

CHUCKS, Power Operated
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Jacobs Mfg. Co., West Hartford 10, Conn.
Universal Engineering Co., Frankenmuth 2 Mich.

CHUCKS, Ring Wheel
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping
Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.

CHUCKS, Universal Three-Jaw
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Wrenchless
Gisholt Mch. Co., Madison 10, Wis.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment

CLEANERS, Metal
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.
Oakite Products, Inc., 26 Rector St., New York, N. Y.

CLUTCHES
Cleveland Punch & Shear Works Co., 3817 St. Clair Ave., Cleveland 14, Ohio.
Conway Clutch Co., 2747 Colerain Ave., Cincinnati 25, Ohio.
Minster Mch. Co., Minster, Ohio.

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National Machinery Co., Tiffin, Ohio.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

COLLETS—See Chucks, Collet

COMBINATION SQUARES—See Machinists' Small Tools

COMPARATORS, Dial, Electronic and Air
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 883, Dayton 1, Ohio.
Starrett, L. S., Co., Athol, Mass.

COMPARATORS, Optical
DoALL Co., Des Plaines, Ill.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y.
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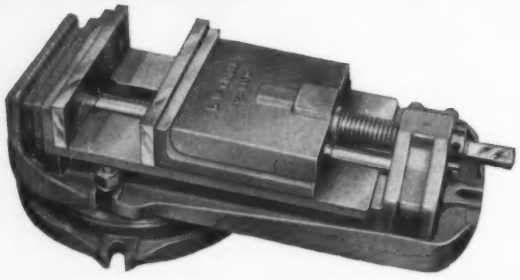

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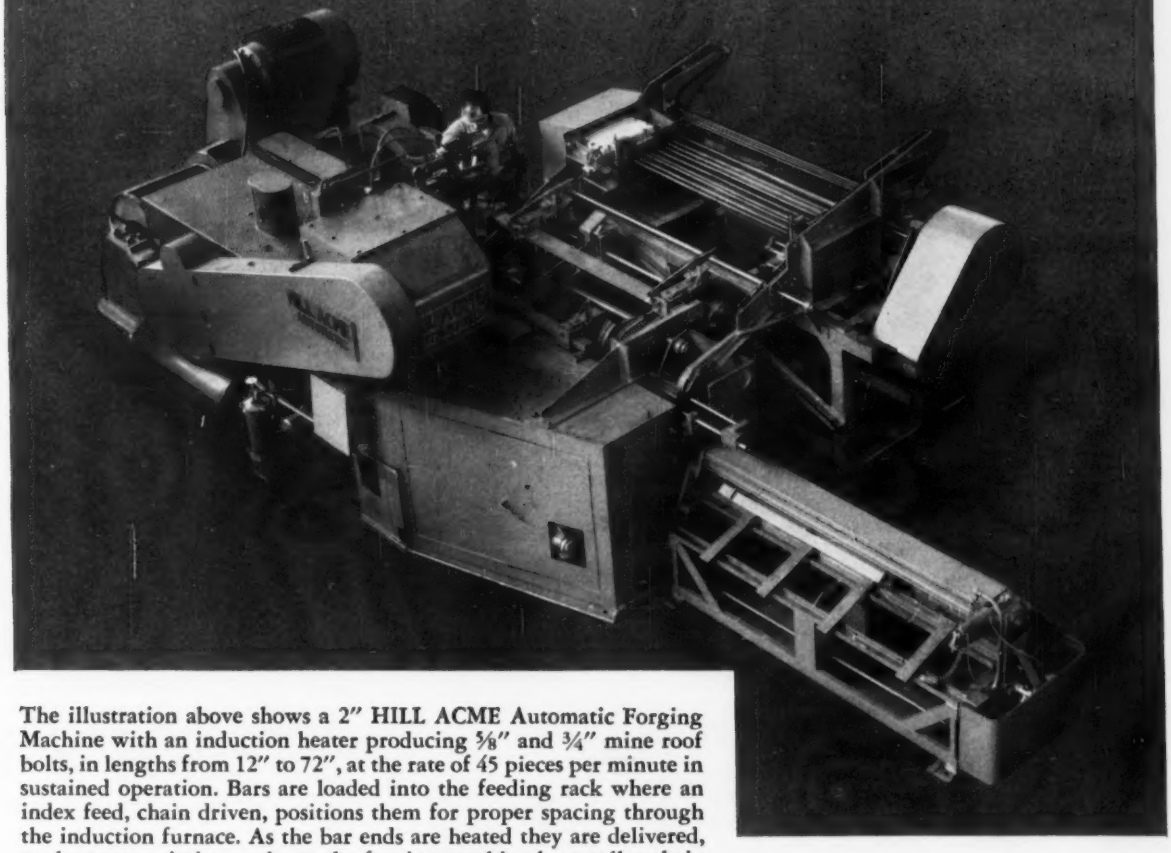

The illustration above shows a 2" HILL ACME Automatic Forging Machine with an induction heater producing 5/8" and 3/4" mine roof bolts, in lengths from 12" to 72", at the rate of 45 pieces per minute in sustained operation. Bars are loaded into the feeding rack where an index feed, chain driven, positions them for proper spacing through the induction furnace. As the bar ends are heated they are delivered, at the proper timing cycle, to the forging machine by a roller chain feed where they are gauged for length, picked up by fingers and passed progressively through the dies. Finished forgings are discharged from the back of the machine by means of a separately driven conveyor, arranged for both right and left hand discharge.

The design of this new HILL ACME AUTOMATIC forging unit does not limit the number of passes or the length of stock to be used in forging a variety of parts. Pieces longer than 36" are supported by a walking beam through the various passes.

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The HILL ACME Company

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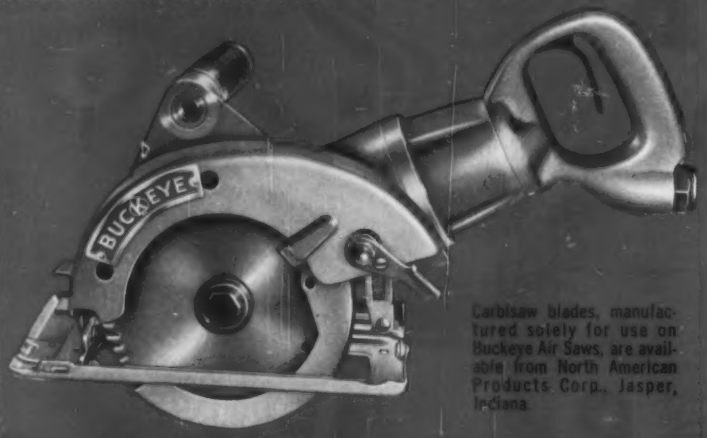
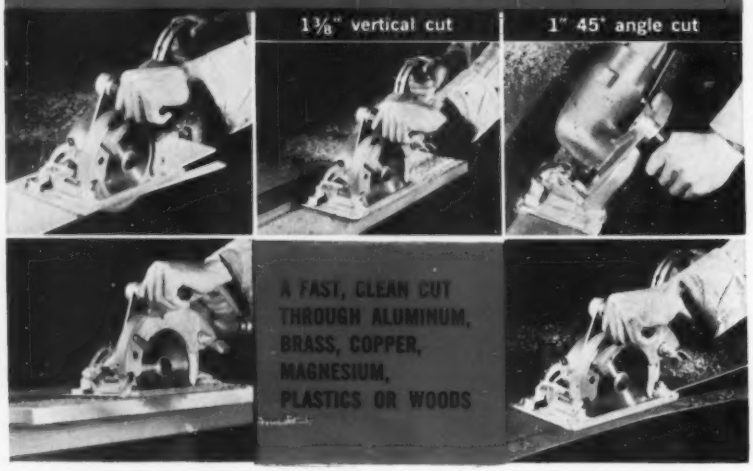


Carbisaw blades, manufactured solely for use on Buckeye Air Saws, are available from North American Products Corp., Jasper, Indiana.



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COMPOUNDS, Cuttings, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

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CONTRACT WORK
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Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Textile Machine Works, Reading, Penna.
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Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

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Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
Cogsdill Twist Drill Co., Greenfield, Mass.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Mohawk Tools, Inc., Montpelier, Ohio.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1200 Woodward Heights Blvd., Detroit 20, Mich.

COUNTERS
Starrett, The L. S., Co., Athol, Mass.

COUPLINGS
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Mueller Brass Co., Port Huron, Mich.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

CRANES, Electric Traveling
Cleveland Crane & Engrg. Co., Wickliffe, Ohio.

CUTTERS, Keyseating
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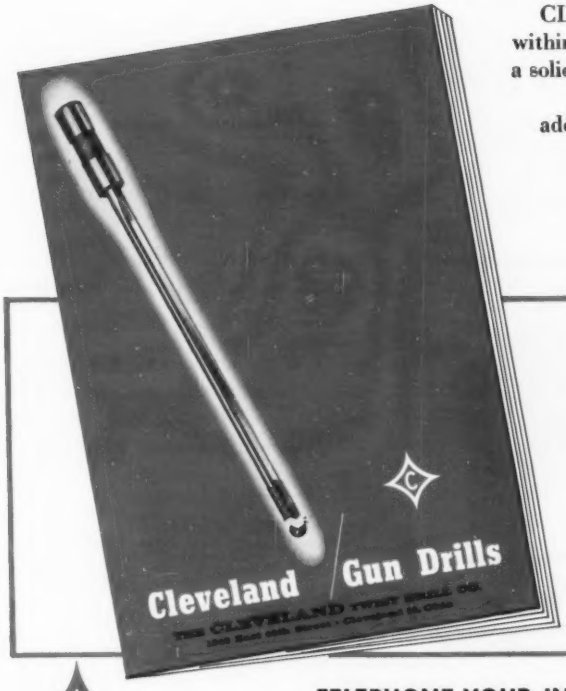
Complete information will be found in the new book shown below.



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Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill (end mills).
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio.
Tomkins-Johnson Co., Jackson, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

CUTTING AND GRINDING FLUIDS
Cincinnati Milling Products Div., Cincinnati, Ohio.
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.
Texaco, Inc., 135 E. 42nd St. New York 17, N. Y.

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Modern Machine Tool Co., Jackson, Mich.

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Johnson Manufacturing Co., Albion, Mich.
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Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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CYLINDERS, Air
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Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.

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Barnes, John S., Corp., 301 S. Water St., Rockford, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Machine Co., Inc., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

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Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

DEMAGNITIZERS
Blanchard Mch. Co., 64 State St., Cambridge, Mass.

DIE CASTINGS—See Casting, Die

DIE CASTING MACHINES
B & T Machinery Co., Rockford, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

DIE CUSHIONS
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Minster Machine Co., Minster, Ohio.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

DIE INSERTS, Carbide
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

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Cratex Mfg. Co., Inc., Burlingame, Calif.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Lempco Industrial, Inc., Bedford, Ohio.
Producto Mch. Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
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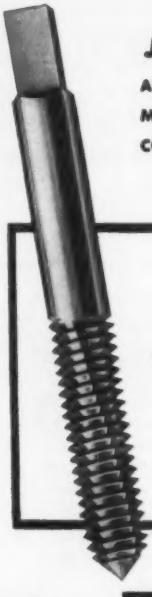

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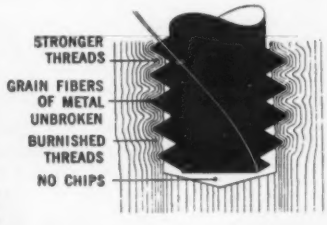

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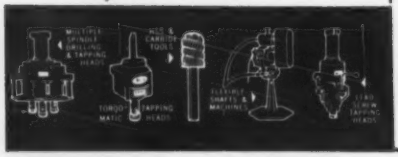

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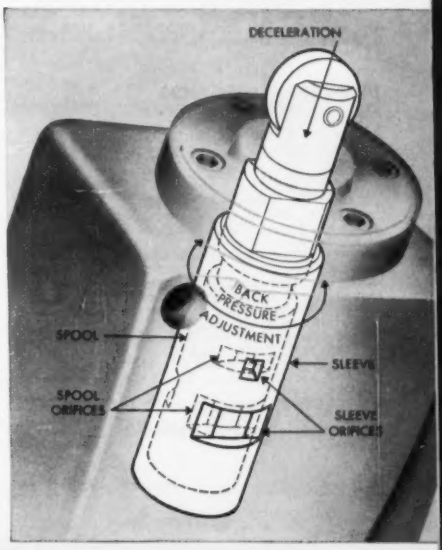

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Vascoloy-Ramet Corp., Waukegan, Ill.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave, Chicago, Ill.
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Wales-Strippit, Inc., Akron, N. Y.

DIES, Self-opening Threading
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Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch Co., Springfield, Vt.
Landis Mch Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.

DIES, Thread Cutting—See Stocks and Dies

DIES, Thread Rolling
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National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.

DIE STEELS
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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.

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DIVIDING HEADS—See Indexing and Spacing Equipment

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Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Norton Co., 1 New Bond St., Worcester, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio.

DRIFT KEYS
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DoALL Co., Des Plaines, Ill.

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Baush Machine Tool Co., 15 Watson Ave., Springfield 1, Mass.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jarvis Corp., Middletown, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Kingsbury Mch. Tool Corp, Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Snow Manufacturing Co., Bellwood, Illinois.

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DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Automatic Tool Co., Inc., S. 7th & N Sts., Richmond, Ind.

DRILLING ATTACHMENTS, Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

DRILLING AND BORING UNITS, Self-contained
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield, Mass.
Buhr Machine Tool Co., 839 Green St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
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Kearney & Trecker Corp., 6784 W. National, Milwauke 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Townsend, H. P. Mfg. Co., Elmwood, Conn.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Baker Brothers Inc., 1000 Post Ave, Toledo 10, Ohio.
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
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Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burg Tool and Mfg. Ct., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 12th St., Milwaukee 10, Wis.
Edlund Mchry. Co., Div., Cortland, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Olofsson Corp., Lansing, Mich.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Hamilton Tool Co., 834 9th St., Hamilton, Ohio.
Homestrand, Inc., Larchmont, N. Y.
Leland-Gifford Co., Box 989, Worcester, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Pratt & Whitney Co., Inc., West Hartford, Conn.
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Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
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Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
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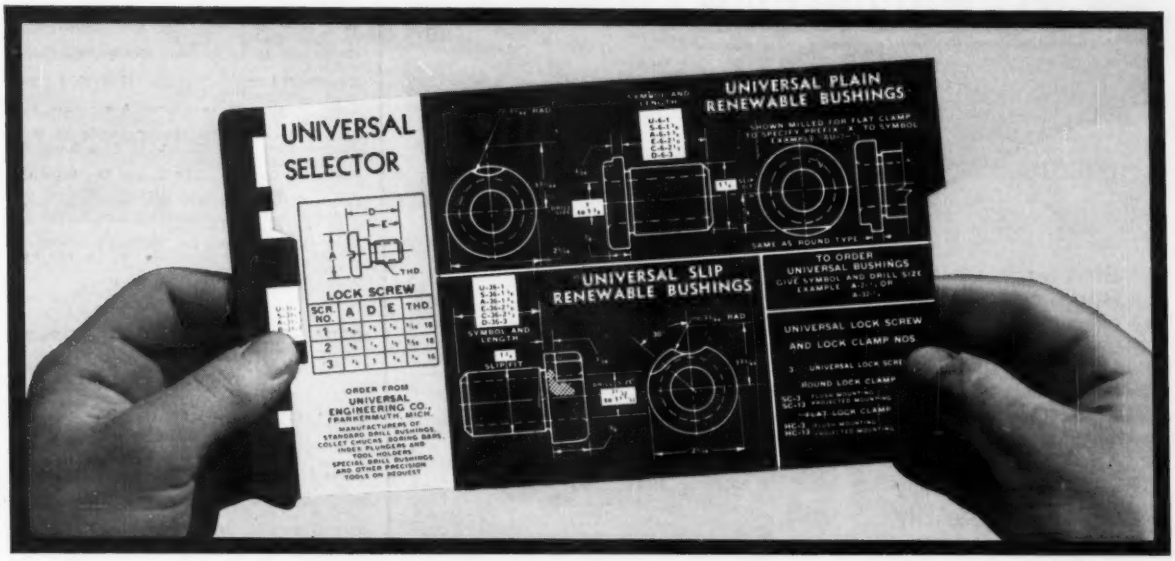
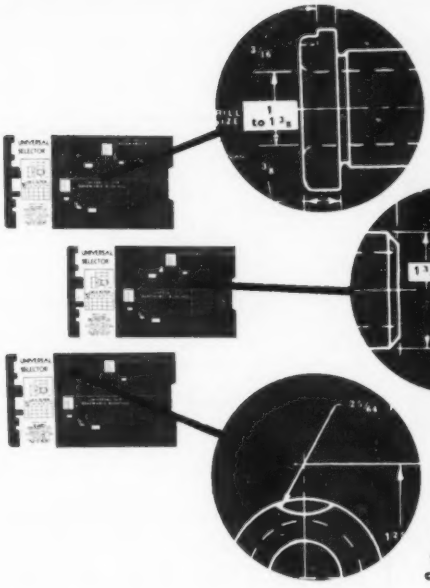
new plastic, pocket-size calculator gives all engineering data for the selection of all types and sizes of drill jig bushings up to 1¾" drill size





The SELECTOR is divided into four areas, one for each of the four types of bushings. The example shown here is for the plain renewable. Using this area, you move the slide until the correct drill size appears in the drill-size window.

Once the drill size is set up on the SELECTOR, all other factors now appear in the windows. This section, for example (shown actual size) shows correct bushing O.D. and dimension from center to flat for clamp.

This section shows the radius for lock screw. Every factor you need for drill bushing jig design as well as for ordering the correct bushing to fit that design is shown correctly, exactly, and at a glance on the SELECTOR.

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BUNTING ALS 16 ALCOA 2
BUNTING AL 1216 ALCOA 2 x 1½
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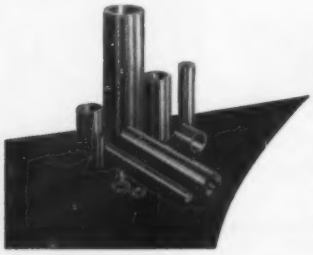

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Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Homestrand, Inc., Larchmont, N. Y.

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Burg Tool and Mfg. Co., Inc., 15001 S. Figuera, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Edlund Machinery Co. Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, St., Cincinnati 23, Ohio.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Leland-Gifford Co., Box 989, Worcester, Mass.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Snow Manufacturing Co., Bellwood, Illinois.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Wales-Strippit, Inc., Akron, N. Y.

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Kaukaua Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.

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Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Mch. Co., 2442 Douglas St.,
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Rehnberg-Jacobson Mfg. Co., 2135 Kishwaukee St., Rockford, Ill.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit, Inc., Akron, N. Y.

DRILLS, Center
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Circular Tool Co., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
Cogsdill Twist Drill Co., Greenfield, Mass.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

DRILLS, Core
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Mohawk Tools, Inc., Mntpelier, Ohio.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

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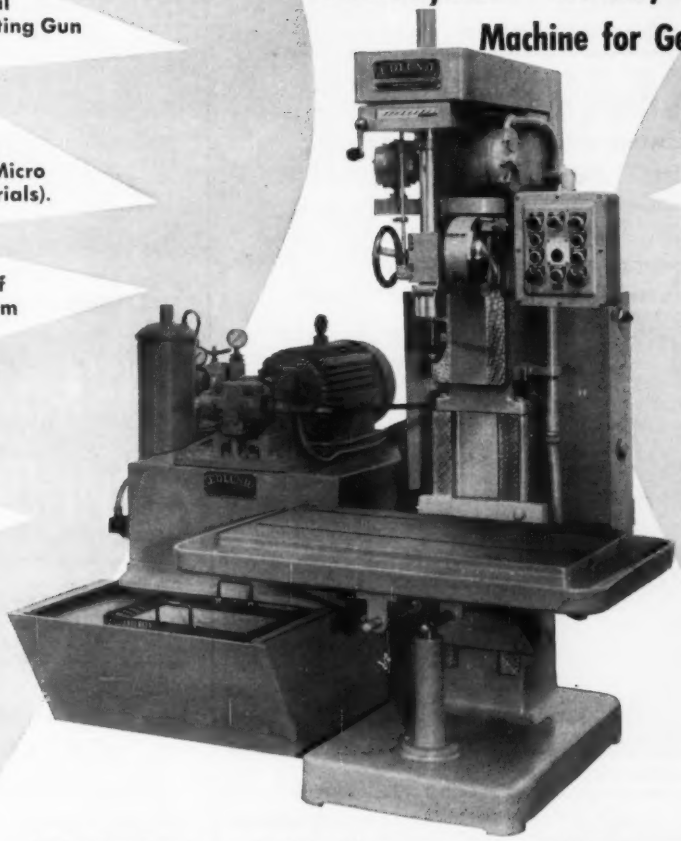

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DRILLS, Deep Hole, Gun
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Eldorado Tool & Mfg. Corp., Milford, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.

DRILLS, Oil Hole, Oil Tube
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.

DRILLS, Portable Electric
Chicago Pneumatic Tool Co., New York 17 N. Y.

DRILLS, Portable pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.

DRILLS, Ratchet
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

DRILLS, Subland
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mohawk Tools, Inc., Montpelier, Ohio.

DRILLS, Twist, High-Speed Steel, Carbon Steel
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield Mass.
Mohawk Tools, Inc., Montpelier, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-Tipped
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Wire
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., Cleveland, Ohio.
Cogsdill Twist Drill Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.

DUPLICATING ATTACHMENTS—See Tracing Attachments

DUST COLLECTORS AND CONTROL SYSTEMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd. Cincinnati 14, Ohio.

ELECTRICAL DISCHARGE MACHINES
—See Disintegrators

ELECTRONIC CONTROL SYSTEMS
Micro-Path Inc., Ingelwood 2, Calif.
Stromberg-Carlson Div., General Dynamics Corp., 1493 N. Goodman St. Rochester 3, N. Y.

ENGRAVING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.

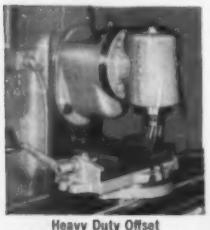
EXTRACTORS, Screw
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

FACING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac. Wis.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

FASTENERS
Allen Mfg. Co., Bloomfield, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

Heavy Duty Vertical Milling Attachment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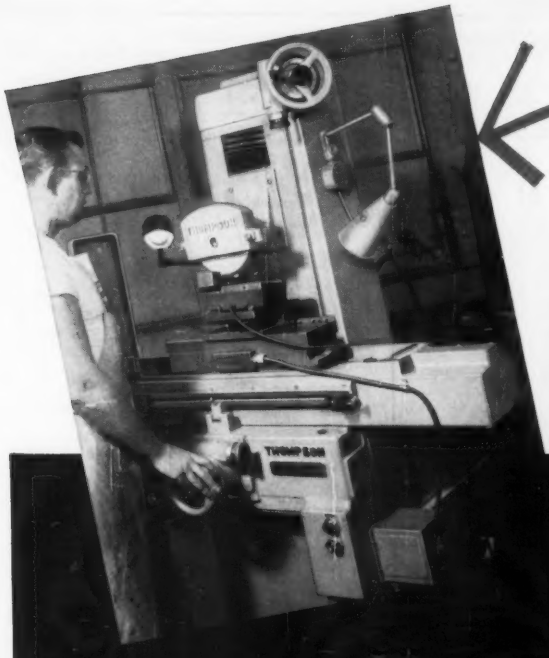

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. . . says Mr. William H. Vogt, Division Superintendent of Parts and Tool Manufacturing at Taylor Instrument Companies, Rochester, N. Y.

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May 7, 1959

Mr. John C. Wilson,
Vice-President, Sales & Engineering
The Thompson Grinder Company
Springfield, Ohio

Subject: THOMPSON Type D Surface Grinder

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Yours very truly,

William H Vogt

William H. Vogt
Division Superintendent
Parts and Tool Manufacturing

whv:lb

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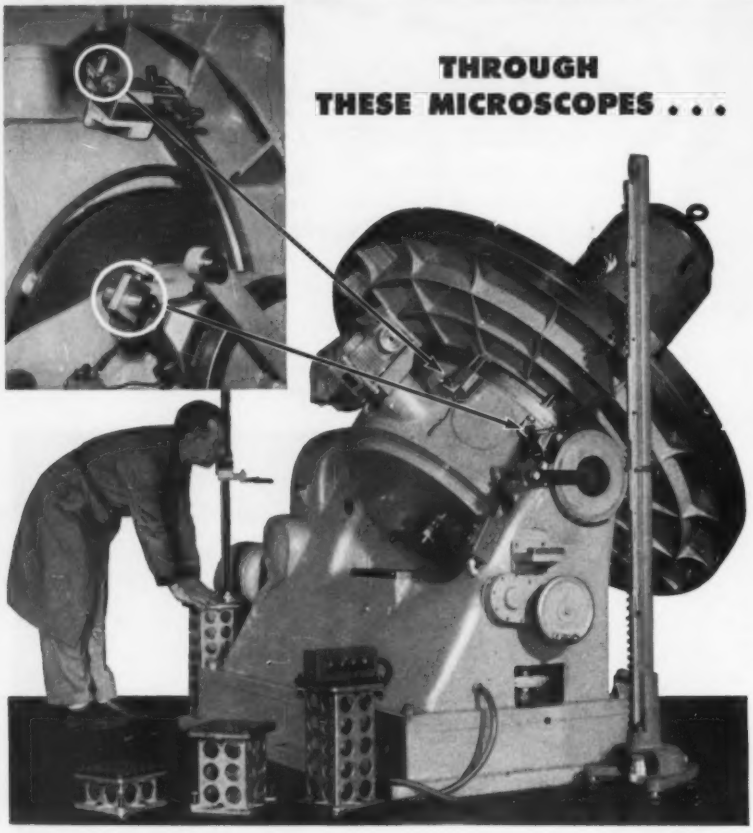

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DoALL Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern
DoALL Co., Des Plaines, Ill.

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Jarvis Corp., Middletown, Conn.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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DoALL Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

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Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Cuno Engineering Corp., Meriden, Conn.
Johnson, S. C. & Son, Inc., Racine, Wis.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.

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Gleason Works, 1000 University Ave., Rochester 3, N. Y.

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Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

FORGING MACHINES, Headers, Upsetters, Presses
Ajax Mfg. Co., 1441 Chardon Rd., Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W. Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
National Machinery Co., Tiffin, Ohio
Waterbury Farrel Foundry & Mch. Co., Waterbury, Conn.

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Mueller Brass Co., Port Huron 35, Mich.

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Mueller Brass Co., Port Huron 35, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Press
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Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)
Vanadium-Alloys Steel Co., Latrobe, Penna.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Upset
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Vanadium-Alloys Steel Co., Latrobe, Penna.

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Michigan Tool Co., Mount Gilead, Ohio
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Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
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Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engrg. Co., Chambersburg, Pa.
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U. S. Tool Co., Inc., 255 North Main St., Ampere, E. Orange, N. J.

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DoALL Co., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Automatic Sorting
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cadillac Gage Co., P. O. Box 3806, Detroit, Mich.
Comtor Co., 47 Farwell St., Waltham 54, Mass.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S. Co., Athol, Mass.

GAGES Electric Comparator
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
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GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper Telescoping Thickness
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Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Roll Thread Snap, Adjustable Snap
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

GAGES, Surface Roughness
DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth
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DoAll Co., Des Plaines, Ill.
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Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
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Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

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Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

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Gleason Works, 1000 University Ave., Rochester 3, N. Y.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR GRINDERS—See Grinding Machines, Gear

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

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GEAR LAPPERS
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Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 12, Mich.

GEAR MOTORS—See Speed Reducers

GEAR RACKS
Stahl Gear & Mch. Co., The, 3901 Hamilton Ave., Cleveland 4, Ohio.

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Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

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Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

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Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio.
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
New Jersey Gear & Mfg. Co., Hillside, N. J.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio

GEARS, Cut
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Marie mont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio.

(*Continued on page 276*)

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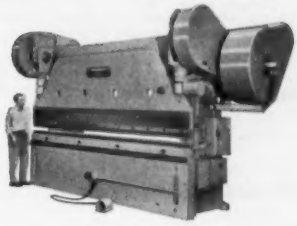

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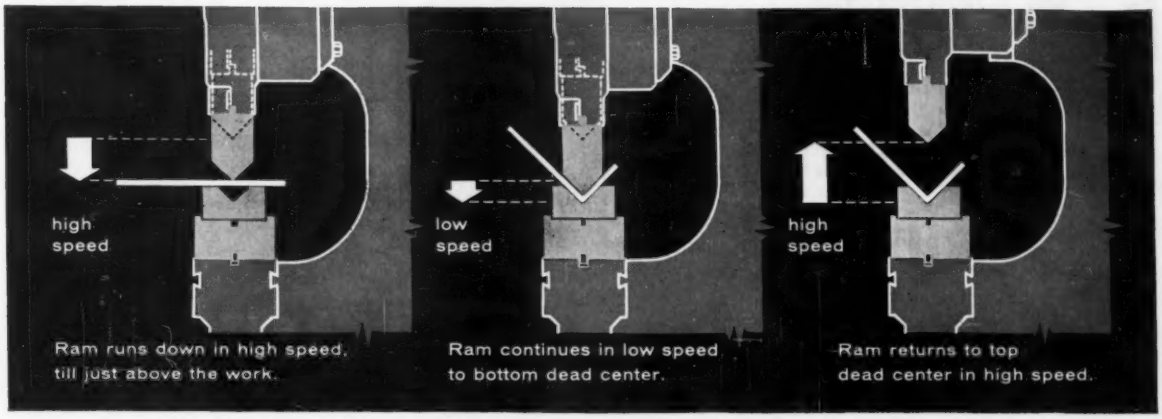
high speed
low speed
high speed
Ram runs down in high speed, till just above the work.
Ram continues in low speed to bottom dead center.
Ram returns to top dead center in high speed.

If you form long, flexible parts, you can increase your production up to 60% with a Cincinnati Automatic Cycle Press Brake.

A new, exclusive feature, the Cincinnati Automatic Cycle provides a combination of instantaneous fast and slow ram speeds with every stroke. As a result, you get maximum production speed without the "whip up" and "back bending" which often occur in high speed forming of long parts which have no beam strength.

You no longer have to rely on the operator's skill at clutch slipping to obtain parts that are free of "back bends."

You can get this money-making feature on all new 7 and 9 Series Cincinnati Press Brakes.

This productive new feature means a lot of advantages for you:

1. Job records show 10% to 60% increase in parts formed per hour.
2. Low speed portion of the ram stroke can be set so that all strokes are identical in length.
3. Rejects caused by "back bends" are stopped.
4. Highly experienced operators are not required.
5. Operator fatigue is greatly reduced because there is no need for clutch slipping.
6. Clutch and brake are long-life, minimum-maintenance units requiring no adjustments.

Write Dept. D for full details about the Cincinnati Automatic Cycle, Bulletin B-9R.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.

For more data, circle this page number on inquiry card

Horsburgh & Scott Co., 5114 Hamilton Ave., Cleveland 14, Ohio
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National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
New Jersey Gear Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.

GRADUATING MACHINES

Gorton Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag

Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Carbide Tool

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.

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Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

GRINDERS, Die and Mold

DoAll Co., Des Plaines, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point

Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Oliver Instrument Co., 1410 E. Maumee, Adrian, Mich. (also drill point thinner)
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.

GRINDERS, Face Mill

Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St. Adrian, Mich.

GRINDERS, Knife and Shear

Hill Acme Co., 1201 W. 65th St. Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric

Chicago Pneumatic Tool Co., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

GRINDERS, Portable Pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y.
Madison-Kipp Corp., Madison, Wis.

GRINDERS, Tap

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.

GRINDERS, Tool and Cutter

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch. Tool Co. Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost

Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES—See Gages, Grinding

GRINDING MACHINES, Abrasive Belt
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach
Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Crankshaft
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc
Brown & Sharpe Mfg., Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Co., Beloit, Wis.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gear Grinding Machine Co., 3901 Christopher St., Detroit 11, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co. 2488-90 River Rd., Cincinnati, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight S. W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile
American Laubscher Corp., Fisk Bldg., 250 W. 57 St., New York 19, N. Y.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc. Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W. Grand Rapids 4, Wis.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Homestrand, Inc., Larchmont, N. Y.
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

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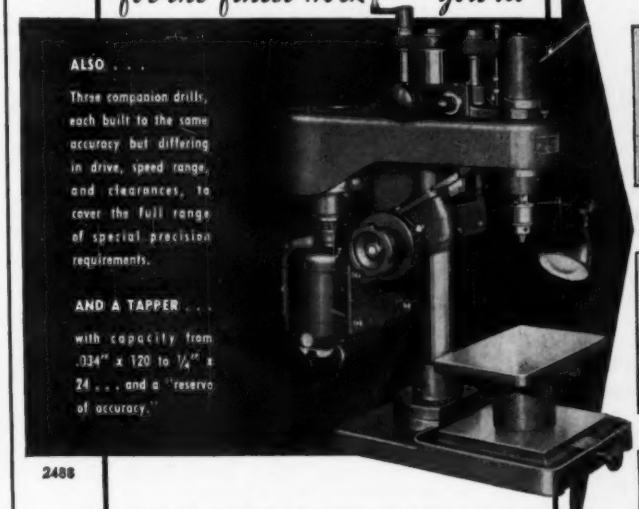

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with capacity from .034" x 120 to 1/4" x 24 . . . and a "reserve of accuracy."

2488

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Blanchard Machine Co., 64 State St., Cambridge, Mass.
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Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Walker, O. S. Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch Co., Springfield, Vt.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

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Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS

Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Metal Carbides Corp., Youngstown, Ohio
Navan Products Inc., 900 N. Sepulveda Blvd., Los Angeles 45, Calif.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GROOVING TOOLS, Internal

Kennametal, Inc., Latrobe, Penna.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.
Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

HAMMERS, Drop—See Forging Hammers

HAMMERS, Portable Pneumatic

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HAMMERS, Power

Chambersburg Engrg. Co., Chambersburg, Pa.
Edlund Mchry. Co. Div., Cortland, N. Y.
Erie Foundry Co, 1253 W. 12th St., Erie Penna.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

HARDNESS TESTERS

Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y.

HEAT-TREATING EQUIPMENT — See Annealing Furnaces, Flame Hardening Machines, Induction-Heating Equipment

HOBS

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

HOISTS, Air

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HOISTS, Electric

Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONING MACHINES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Moline Tool Co., 102-120th St., Moline, Ill.
Superior Hone Corp., 1623 Elreno St., Elkhart, Ind.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

HONING STONES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

HOSE

American Metal Hose Br. American Brass Co., 25 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

HYDRAULIC MACHINERY
Tools and equipment

Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Bliss, E. W., Co., 1375 Raff Rd., E. W. Canton, Ohio
Burg Tool and Mfg. Co., Inc., 15001 S. Figueora, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., Erie, Pa.
Hydraulic Press Mfg. Co., Mount Gilead Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
Northern Hydraulics & Mch. Corp., Melrose Park, Ill.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sundstrand Mch Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Vickers Incorporated, Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

FASTER AUTOMATIC CUT-OFF
Tubing, Pipe and Bar Stock

the Modern Way

Automatic operation—from loading to final cut-off. Handles solid bar stock up to 3" O.D.—tubing up to 8" O.D. Cuts any material that can be turned. 16 spindle speeds.

107

The Modern Automatic Cutting-Off Machine and Bar Feeder Combination, shown above, handles random lengths of tubing, pipe and bar stock. With this combination the entire load is fed to the cutting-off machine without attention of an operator. Feeders are available for any maximum length bars. Only one single crank adjustment needed—for stock diameter.

WRITE FOR CATALOG

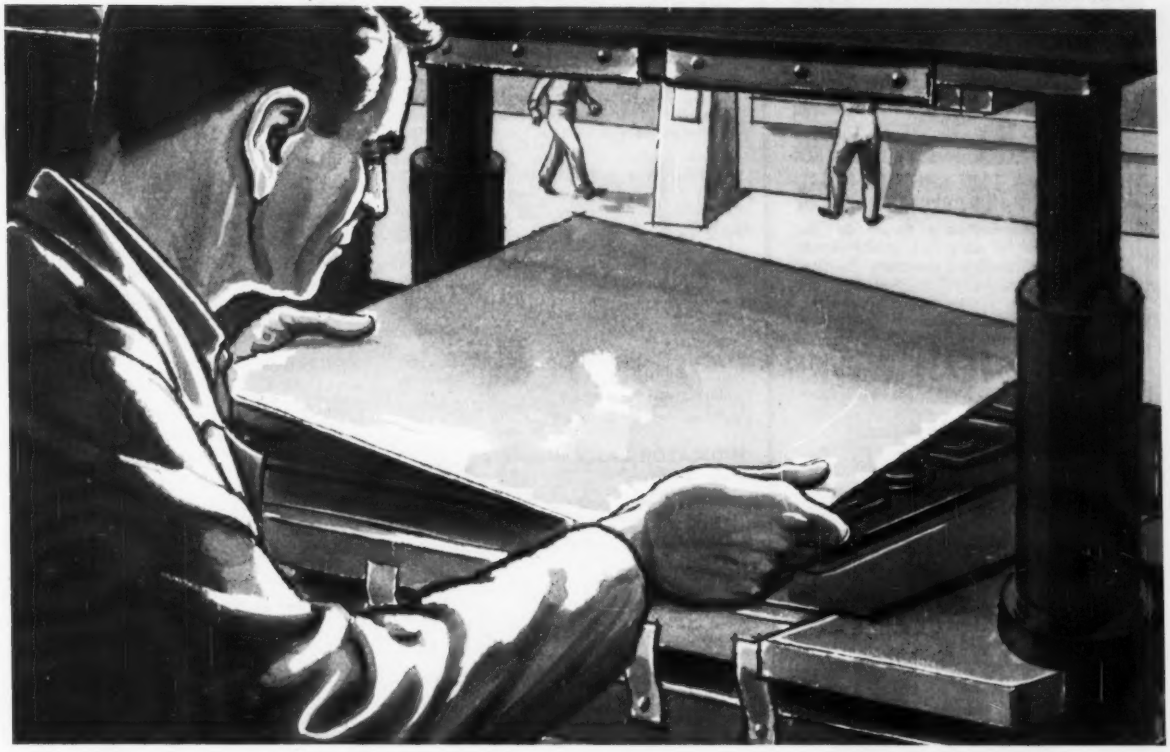
Has complete specifications of all models. Illustrates parts that are being formed, grooved, flanged or chamfered and cut off in a single operation at a high rate of speed. Also describes the automatic feeder, hot spinning machine for sealing ends of tubing, and the Modern Safety Drill Table.

MODERN MACHINE TOOL CO.
2005 LOSEY AVENUE
Jackson, Michigan

For greater ease in aluminum drawing

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS



Oakite DRAW CLEAN "M" gives smooth drawing of aluminum, cleans off fast

Using Oakite DRAW CLEAN "M" lubricant means a lower reject rate on drawing and forming aluminum. Reason: It clings to metal so tenaciously that pressures of 40 thousand psi, encountered in drawing and punching cannot wipe it off. The thinnest film will prevent seizure that leads to build-up, galling, and scratching.

All ingredients are soluble and, at annealing temperatures, volatile. This means that while it clings where most compounds wipe off, nevertheless, it is most easy to remove when necessary. And the residue, if left on, is not harmful to metal or personnel.

Oakite DRAW CLEAN "M" lubricant offers astonishing savings. By diluting with water in ratios as high as 1 to 9 it extends die life three times the previous experience. Miscible with both water and oil, it is adaptable to any of the following:

light stamping	stretch forming	tapping
deep drawing	tube bending	spinning
cold heading	wet grinding	punching

Oakite Bulletin F-10393 tells you the whole story. For your free copy ask your Oakite man or write Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

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years' leadership in industrial cleaning

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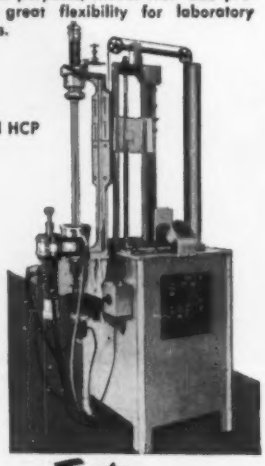
Lepel induction heating equipment represents the most advanced thought in the field of electronics . . . the most practical and efficient source of heat developed for numerous industrial applications.
You are invited to send samples of work with specifications. Our engineers will process and return the completed job with full data and recommendations without cost or obligations

FLOATING ZONE UNIT FOR METAL REFINING AND CRYSTAL GROWING

A new floating zone fixture for the production of ultra-high purity metals and semi-conductor materials. Purification or crystal growing is achieved by traversing a narrow molten zone along the length of the process bar while it is being supported vertically in vacumm or inert gas. Designed primarily for production purposes, Model HCP also provides great flexibility for laboratory studies.

Model HCP



Features

- **A smooth, positive mechanical drive system with continuously variable up, down and rotational speeds, all independently controlled.**
- **An arrangement to rapidly center the process bar within a straight walled quartz tube supported between gas-tight, water-cooled end plates. Placement of the quartz tube is rather simple and adapters can be used to accomodate larger diameter tubes for larger process bars.**
- **Continuous water cooling for the outside of the quartz tube during operation.**
- **Assembly and dis-assembly of this system including removal of the completed process bar is simple and rapid.**

Electronic Tube Generators from 1 kw to 100 kw.
Spark Gap Converters from 2 kw to 30 kw.
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LEPEL HIGH FREQUENCY LABORATORIES, INC.
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Barnes, W. F. & John Co., 201 S. Waterford St., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

INDEXING and SPACING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
du Mont Corp., Greenfield, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, L. S. Co., Athol, Mass.

INDICATORS, Dial

Ames, B. C., Waltham 54, Mass.
Brown & Sharpe Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th - N. Sts., Richmond, Ind.
Starrett, The L. S. Co., Athol, Mass.

INDICATORS, Speed

Brown & Sharpe Mfg Co., Providence, R. I.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Starrett, The L. S. Co., Athol, Mass.

INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th & N. Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, The L. S. Co., Athol, Mass.

INDUCTION HEATING EQUIPMENT

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lepel High Frequency Laboratories, Inc., Woodside 77, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INTENSIFIERS, Hydraulic

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Oilgear Co., 1560 W Pierce St., Milwaukee 4, Wis.

JACKS, Planer—See Set-up Equipment

JIG BORERS

American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Homestrand, Inc., Larchmont, N. Y.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.
Orban, Kurt., Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIGS AND FIXTURES

Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

KEYSEATERS

Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

KNURLING TOOLS

Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Williams J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LAPPING MACHINES

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 Univedsity Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

LATHE ATTACHMENTS

Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co:. Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio
Williams, J. H. & Co, 400 Vulcan St., Buffalo 7, N. Y.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle

Consolidated Mch. Tool Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp. Hamilton, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench

Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Car Wheel
Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio

LATHES, Copying, Duplicating — See Lathes, Duplicating

LATHES, Crankshaft
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds, Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Double-End
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co, Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

LATHES, Duplicating
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney Ohio
Sidney Machine Tool Co., Highland Ave. Sidney, Ohio

LATHES, Engine, Manufacturing
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Consolidated Mch. Tool Div, Blossom Road. Rochester 10, N. Y.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place. Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio

LATHES, Engine, Toolroom
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Logan Engineering Co., 4901 Lawrence Ave., Chicago 30, Ill.
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio

LATHES, Gap
Cincinnati Lathe & Tool Co., 3207 Disney St. Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Sidney Machine Tool Co., Highland Ave. Sidney, Ohio

LATHES, Hollow Spindle
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
South Bend Lathe Works Inc., 425 E. Madison St., South Bend, Ind.

LATHES, Roll
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
Bliss, E. W., Co., Canton, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

LATHES, Speed, Second-operation
Gisholt Machine Co. 1245 E Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning
Cincinnati Milling & Grinding Mches., Inc. 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17 N. Y.
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.

LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave. Madison 10, Wis
Jones & Lamson Mch. Co., 512 Clinton St. Springfield, Vt.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Dive., New Britain, Conn.

LATHES, Turret, Ram Type Saddle Type
Bardons & Oliver, Inc., 1133 W. Ninth St. Cleveland 13, Ohio
Bullard Co., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave. Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St. Springfield, Vt.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Sheldon Mach. Co., Inc., 4258 N Knox Ave. Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave. Cleveland 3, Ohio

LATHES, Turret, Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St. Providence 1, R. I.
Starrett, L. S., Co., Athol, Mass.

LEAD SCREWS & SPLINES, Ball Bearing
Saginaw Steering Gear Div., General Motors Corp., Saginaw Mich.

LEVELS
Starrett, The L. S. Co., Athol, Mass.

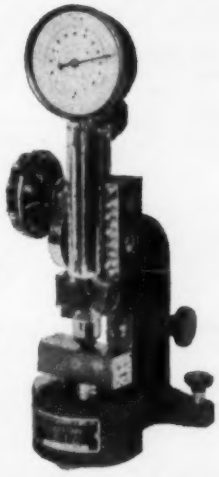
LIMIT SWITCHES—See Switches, Limit

LUBRICATING OILS and GREASES
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.

(*Continued on page 282*)

"SHORE for SURE"
HARDNESS TESTING

Shore's Improved Direct Reading Scleroscope (above) and Standard Recording Scleroscope (below) with dial graduated in standard Scleroscope and equivalent Brinell and Rockwell "C" Hardness Numbers, are able to perform over 1000 hardness tests per hour. Both Scleroscopes are completely portable, operative on all types and sizes of metals, are reliable in hands of non-technical help, and show no visible injury signs on finished surfaces. Write for free brochures on these instruments.



Direct Reading Scleroscope shown above with special Swing Arm & Post Assembly. Height capacity 9", reach 14". To be mounted on bench for testing large objects. Supplied with two test blocks and diamond hammer.

Standard Recording Scleroscope (right) with Clamping Stand, jaw capacity 3" high x 2½" deep. Supplied with following accessories: diamond hammer, hard and soft test block, V block for testing rounds, and steel carrying case.

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90-35 Van Wyck Expressway, Jamaica 35, N. Y.

Shell Oil Co., 50 W. 50th St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S Michigan, Chicago, Ill
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.
Texaco, Inc., 135 E. 42nd St. New York 17, N. Y.

LUBRICATING SYSTEMS

Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago 23, Ill.
Madison-Kipp Corp., Madison, Wis.

MACHINERY, Used and Rebuilt

Eastern Mchry. Co., 1000 Tennessee Ave., Cincinnati, Ohio
Miles Mchry. Co., 2025 E. Genessee Ave., Saginaw, Mich.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Van Keuren Co., Watertown 72, Mass.

MACHINISTS' SMALL TOOLS

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Starrett, The L. S., Co., Athol, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.
Williams, J. H & Co., 400 Vulcan St., Buffalo 7, N. Y.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., 721 Springfield St., Dayton, 1, Ohio
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MEASURING WIRES—Thread, Spline, Gear

Sheffield Corp., Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MICROMETER HEADS

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Starrett, The L. S., Co., Athol, Mass.

MICROMETERS, Outside, Inside, Depth

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S., Co., Athol, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MICROSCOPES, Toolmakers'

DoALL Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

MILLING MACHINE ATTACHMENTS

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Mch. Co., Inc., 4258 N Knox Ave., Chicago 41, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Automatic

Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Cincinnati Milling Machine Co., Cincinnati, Ohio
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bed Type, Simplex, Duplex

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling & Grinding Mches., Inc., 470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Wrks., Front St., and Girard Ave., Philadelphia, Pa.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island 1, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Bench, Hand

Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.

MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Espen Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Snyder Tool & Engrg. Co., 3400 E. Layfayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U.S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

MILLING MACHINES, Knee Type Ram

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Turret

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches,, Inc. 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 11110 W. 13th St., Racine, Wis.
Homestrand, Inc., Larchmont, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

MILLING MACHINES, Planer Type

Berthiez, Charles, 5 Rue Montalivet, Paris, France
Consolidated Mch, Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker, Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exrhange Place, Jersey City, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar

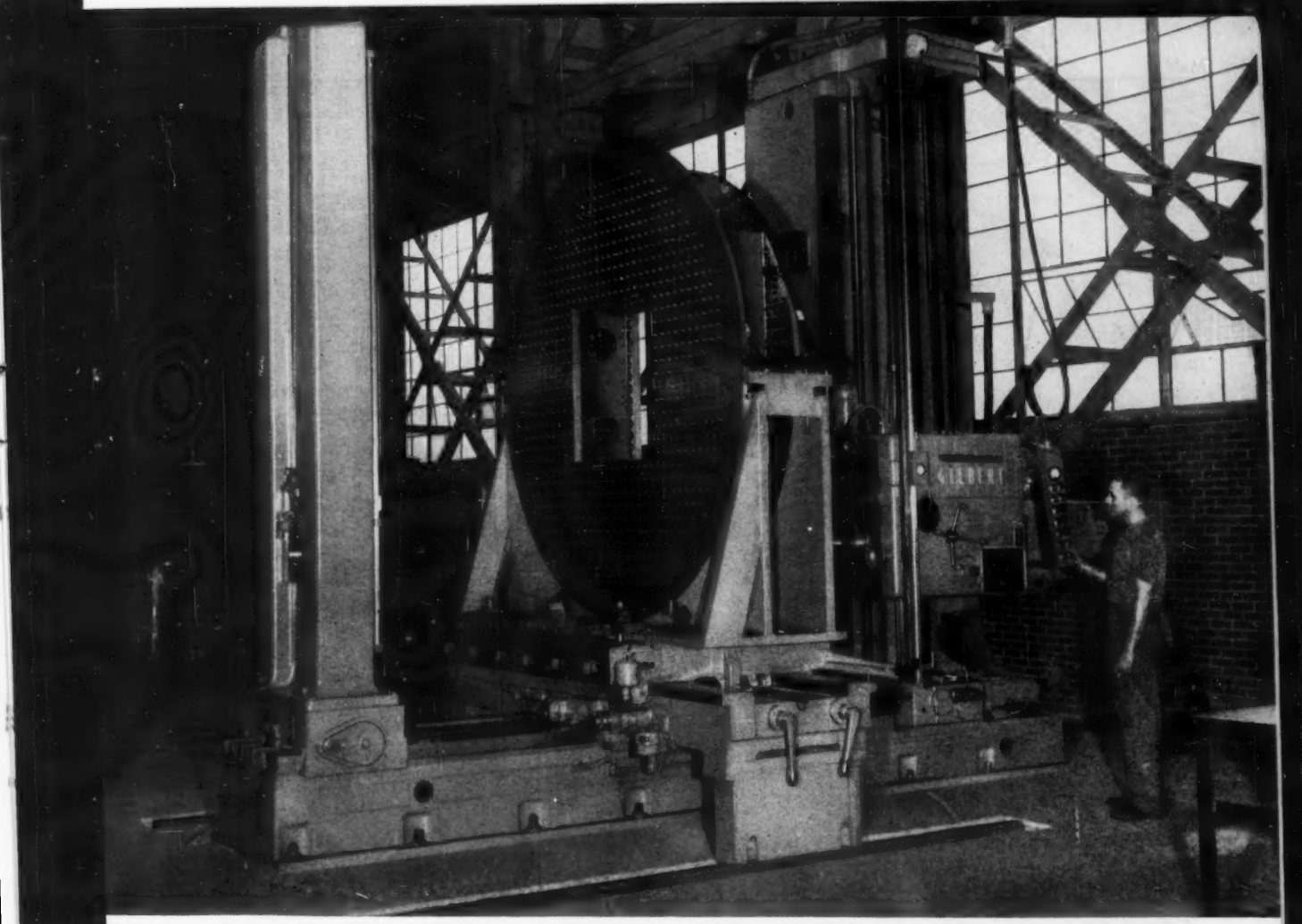
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MOLDING MACHINES, Plastic

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

MOTORS, Air

Ingersoll-Rand Co., Phillipsburg, N. J.



Courtesy Combustion Engineering, Inc.

Combustion Engineering uses Gilberts for precision boring on atomic reactors

It takes an unusual boring mill (specifically, a Cincinnati Gilbert) to meet the specifications on this job:

(a) diameters within .001″,

(b) parallelism of center line of holes to center line of plate within .0001″ per inch,

(c) parallelism of flat surfaces within .010″,

(d) 32 R.M.S. surface finishes.

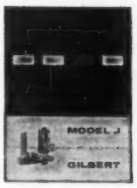
These are some of the machining requirements on this part for a fast breeder reactor built in the Chattanooga plant of Combustion Engineering, Inc., pioneer manufacturer in the nuclear field. They are typical of the quality of work assigned to this Cincinnati Gilbert table type horizontal boring mill. Automatic positioning makes work-handling fast and precise.

A number of other Gilbert boring mills are producing similar close-tolerance work for Combustion Engineering—proof that "those who buy Gilbert buy Gilbert again."

New Bulletin 1157 will show you why Gilbert boring mills do so many things so well.

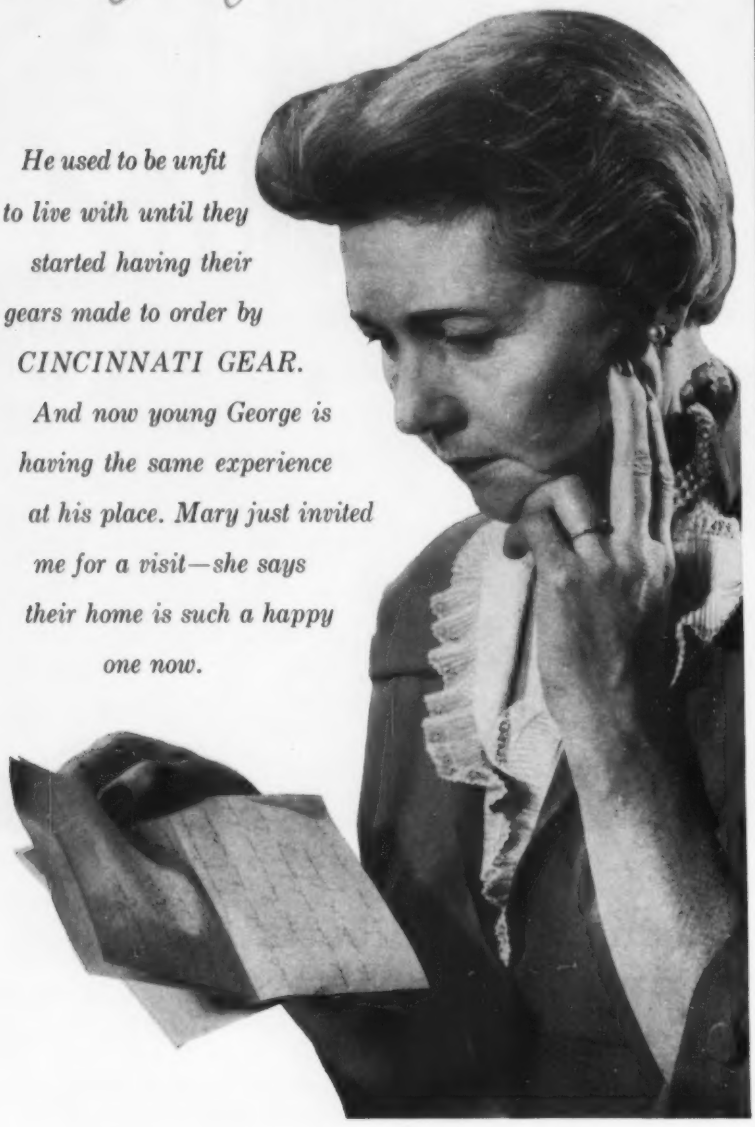
The Cincinnati Gilbert Machine Tool Co., 3346 Beekman Street, Cincinnati 23, Ohio.

Ask for free catalog 1157



GILBERT

My George was like that...



He used to be unfit to live with until they started having their gears made to order by CINCINNATI GEAR. And now young George is having the same experience at his place. Mary just invited me for a visit—she says their home is such a happy one now.

Guaranteed quality and reliability of product through the years have earned for us a long list of thoroughly satisfied customers. Send prints of your custom gear and gear box requirements for quotation.

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Custom Gear Makers Since 1907

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MOTORS, Hydraulic
Barnes, John S. Corp., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

MULTIPLE INSPECTION GAGES—See Gages, Multiple Inspection

MULTIPLE-STATION MACHINES, Dial Type
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
National Automatic Tool Co., S. 7th N. St., Richmond, Ind.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

MULTIPLE-STATION MACHINES, Transfer Type
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
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Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
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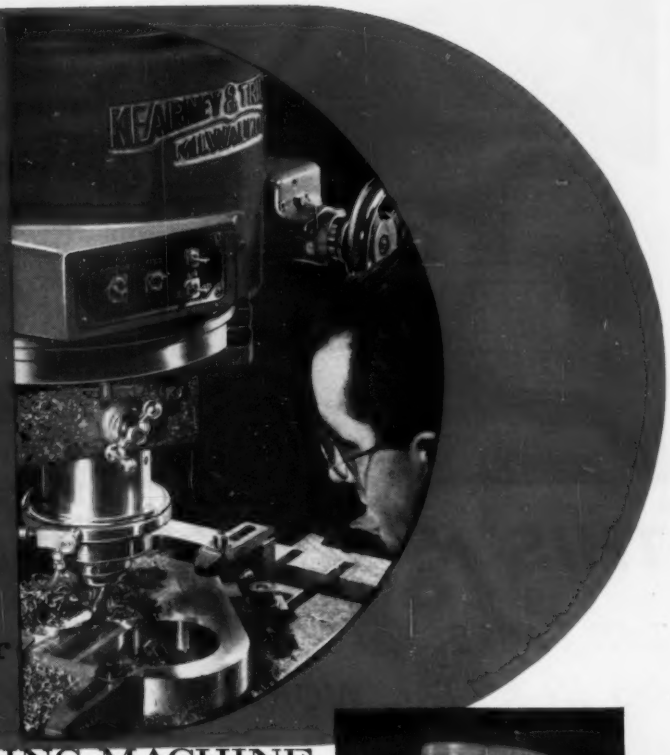

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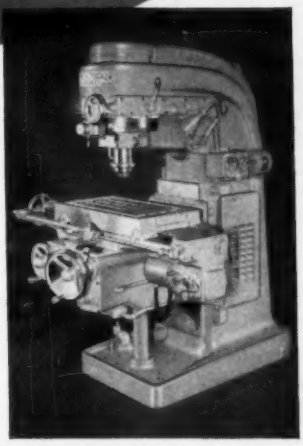

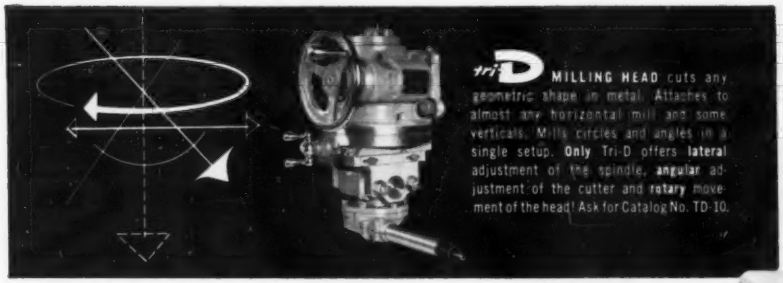

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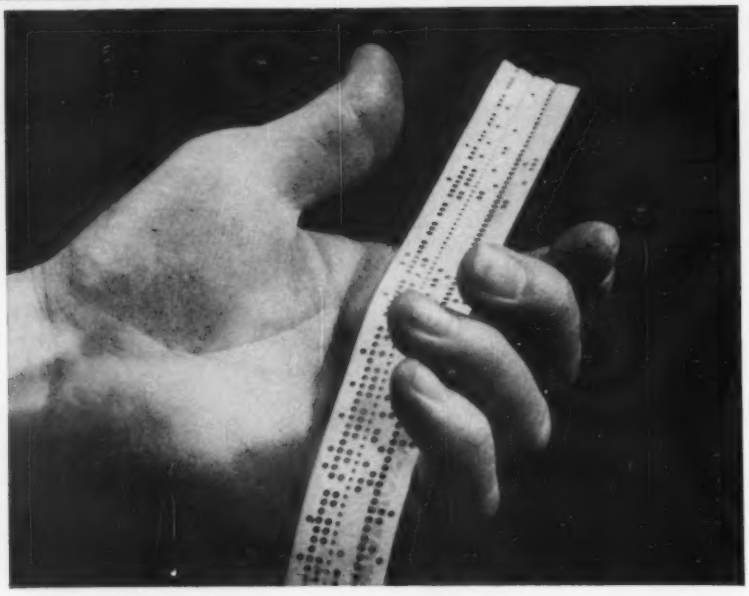

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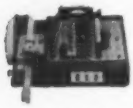

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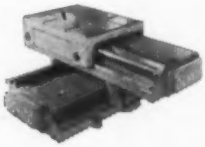

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DoALL Co., De Plaines, Ill.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
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Walker, O. S., Co., Inc., Worcester, Mass.

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(*Continued on page 288*)

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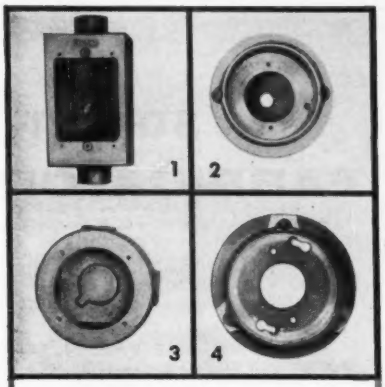

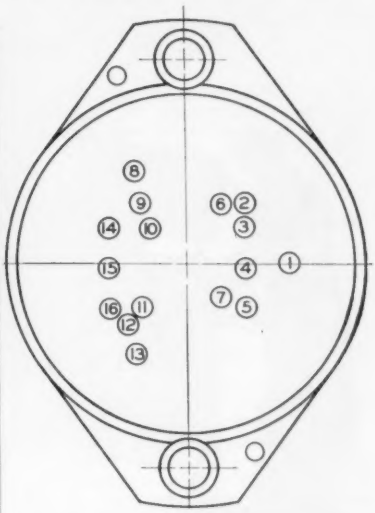

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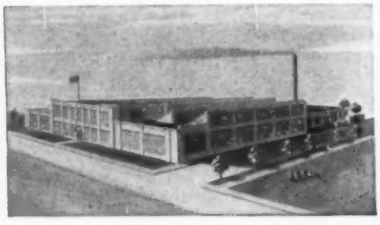

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L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
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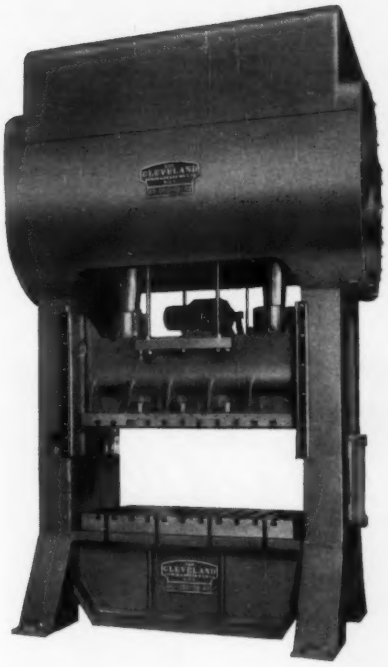

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(Continued on page 294)

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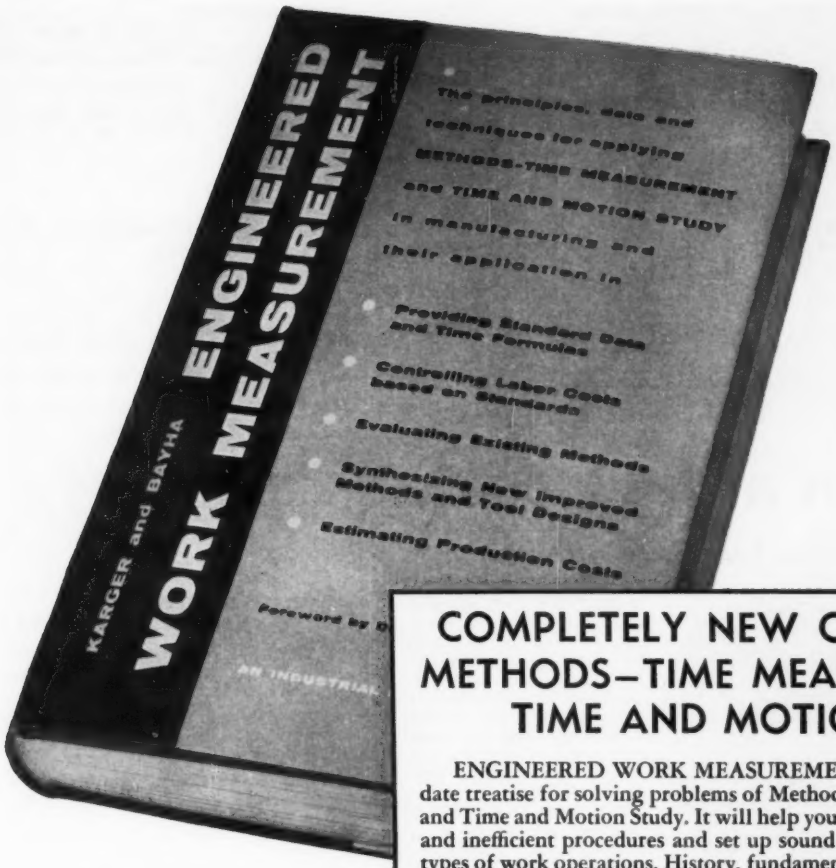
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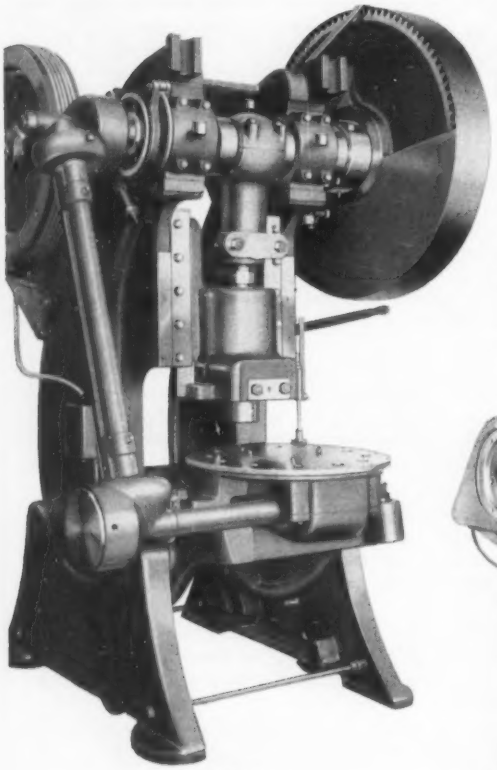

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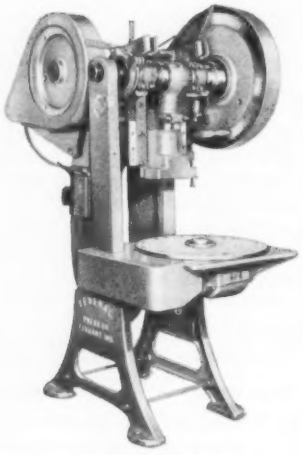

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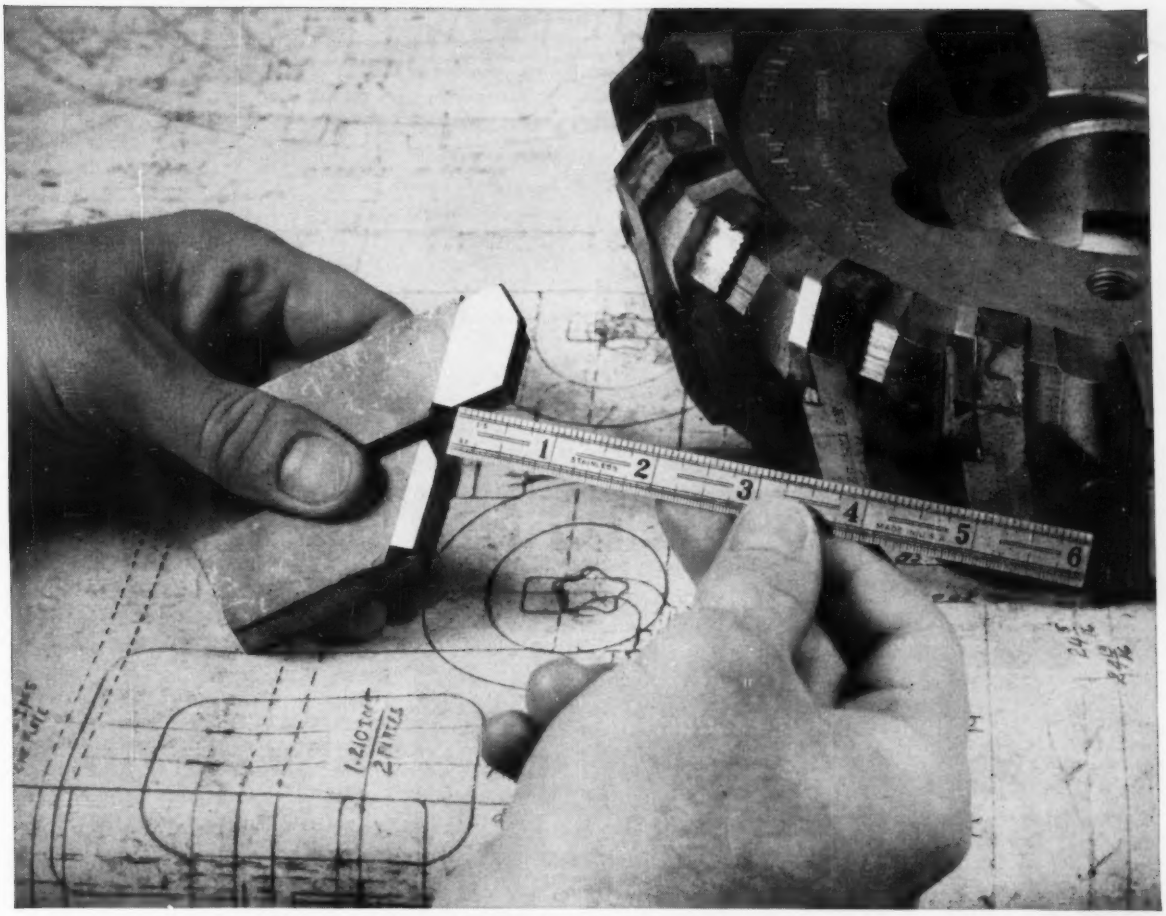
(Continued on page 296)



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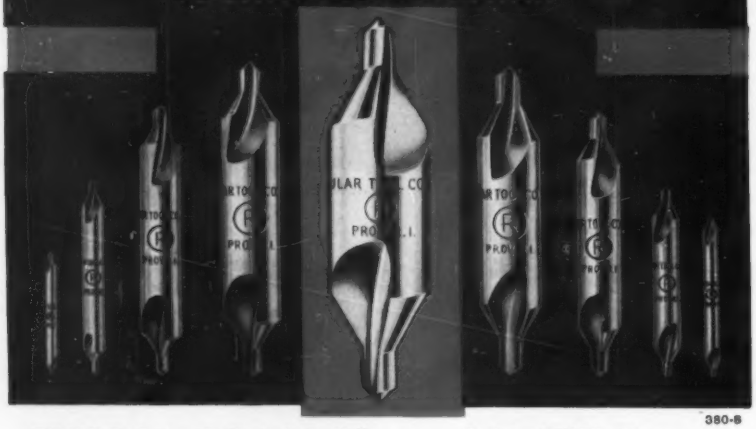

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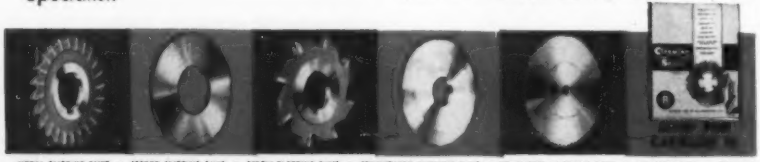

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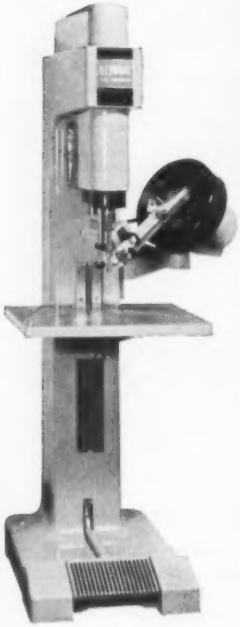

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SOCKETS—See Drill Sleeves and Extension Holders

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National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

SPECIAL MACHINERY AND TOOLS

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., 201 S. Water St., Rockford, Ill.
Baush Machine Tool Co., 156 Wason Ave., Springfield 7, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio.
Columbus Die-Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Erie Foundry Co., Erie, Pa.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
Greenlee Bros. & Co., 12th and Columbia Aves., Rockford, Ill.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keen, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sheffield Corp., Box 893, Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio.
Sundstrand Mch. & Tool Co., 2531 11th St., Rockford, Ill.
Universal Engrg. Co., Frankenmuth 2, Mich.
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

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Barnes, John S. Corp., Rockford, Ill.
Boston Gear Works, 320 Main St., North Quincy 71, Mass.
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.

SPINDLES, Machine
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Standard Electrical Tool Co., 2488-90 River Road, Cincinnati, Ohio.

SPRAYING EQUIPMENT, Metal
Metallizing Eng. Co., Westbury, L. I., N. Y.

SPROCKETS—See Gears, Cut

STAMPINGS, Sheet Metal
Laminated Shim Co., Inc., Glenbrook, Conn.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

STEEL ALLOYS—See Alloy Steels

STEEL, Cold Rolled, Stainless, High-speed, Tool, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Jessop Steel Co., Washington, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Timken Roller Bearing Co., Canton, Ohio.
Vanadium-Alloys Steel Co., Latrobe, Penna.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL DISTRIBUTORS
Ryerson, Jos. T., & Son, 16th & Rockwell Sts., Chicago 8, Ill.

STOCKS AND DIES
DoALL Co., Des Plaines, Ill.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

STRAIGHTEDGES—See Machinists' Small Tools

STRAIGHTENERS, Flat Stock and Wire
Bliss Co., E. W., Canton, Ohio.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
U. E. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

STRIP AND SHEET, Ferrous
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STRIP AND SHEET, Non-ferrous
American Brass Co., 25 Broadway, New York, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
Jessop Steel Co., Washington, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

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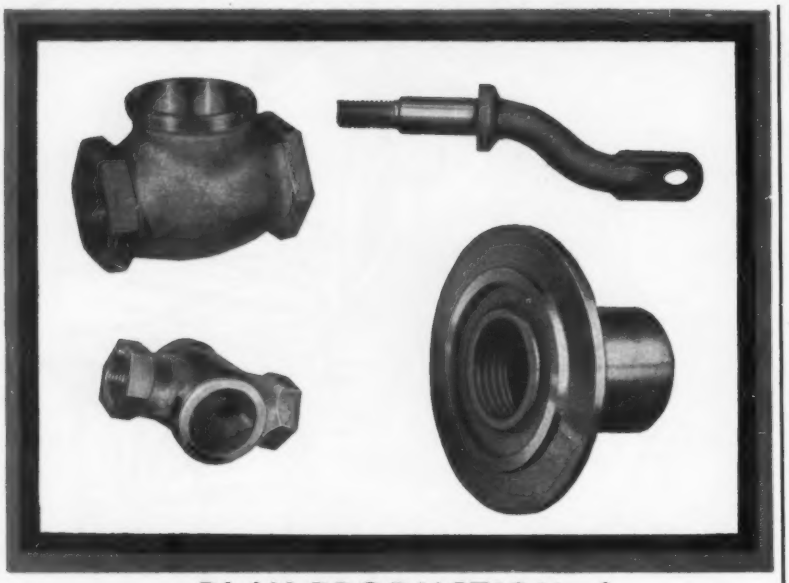

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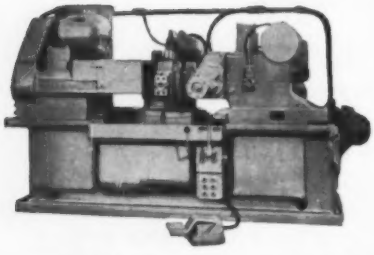

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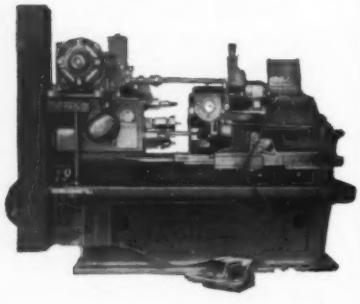

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SWITCHES, Limit
Allen-Bradley Co., 1331 So. 1st St., Milwaukee, Wis.

TACHOMETERS—See Indicators, Speed

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.

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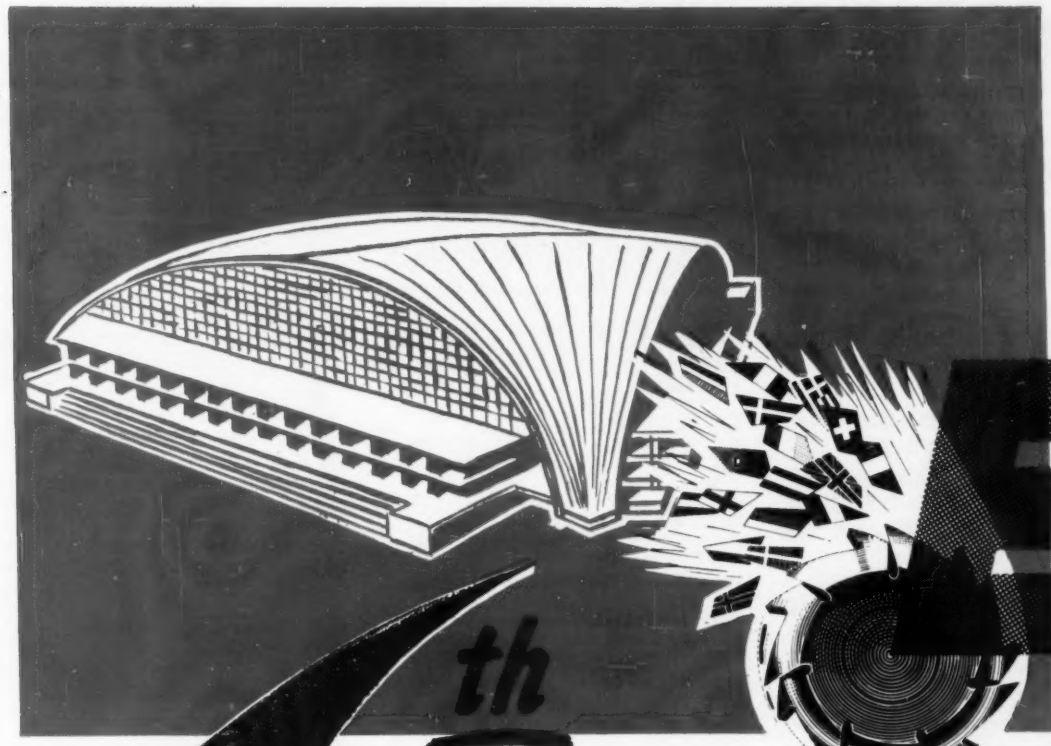
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jarvis Corp., Stack Ave., Middletown, Conn.
Kato Mfg. Co., Osaka, Japan.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., 1425 Southbridge St., Worcester, Mass.
National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

TAPPING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Baush Machine Tool Co., 15 Wason Ave., Springfield 7, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Cincinnati Bickford Div. of Giddings & Lewis Mch. Tool Co., Oakley, Cincinnati 9, Ohio.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Edlund Machinery Co., Cortland, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaufman Manufacturing Co., Manitowoc, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Landis Mch. Co., Waynesboro, Pa.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

TAPS, Hand, Machine Screw, Pipe, etc.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jarvis Corp., Stack Ave., Middletown, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Threadwell Tap & Die Co., Greenfield, Mass.
Winter Bros. Co, Rochester, Mich.

TAPS, Collapsing
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.



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THREAD CUTTING MACHINES
Davis & Thompson Co., 4460 W. 124th St., Milwaukee 10, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

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Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

THREAD ROLLING DIES—See Dies, Thread Rolling

THREAD ROLLING EQUIPMENT
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio.
National Machinery Co., Tiffin, Ohio.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Waterbury Farrel Foundry & Mch. Co., Waterbury, Conn.

TOOL CONTROL BOARDS
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.

TOOL HOLDERS
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Bridgeport Mches, Inc., 500 Lindley St., Bridgeport 6, Conn.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

TOOL MATERIAL, Cast Non-Ferrous Alloy
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, Cemented Carbide
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

TOOL MATERIAL, Ceramic
Metal Carbides Corp., Youngstown 12, Ohio.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
du Mont Corp., Greenfield, Mass.
Jessop Steel Co., Washington, Penna.
Vanadium-Alloys Steel Co., Latrobe, Penna.

TRACING ATTACHMENTS
American Tool Works Co., Pearl & Eggleston Aves., Cincinnati 2, Ohio.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Wales-Strippit, Inc., Akron, N. Y.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

TRANSFER MACHINES
See Multiple-Station Machines

TRANSMISSION, Variable Speed
Barnes, John S. Corp., Rockford, Ill.
Boston Gear Wks., Quincy, Mass.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus, Ohio.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

TRUCKS, Material Handling
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.

TUBE-FLANGING MACHINES
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.

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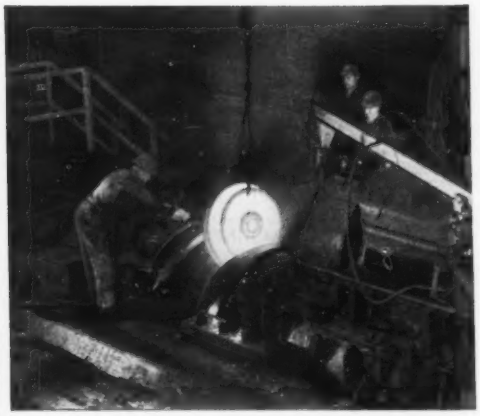
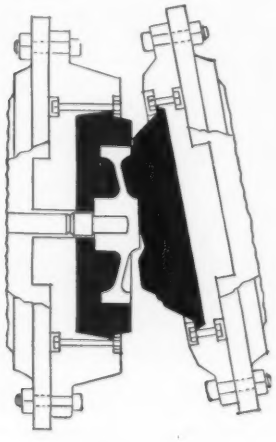
Unique Mill Forges and Rolls circular products in one operation

In less than one minute, this Bethlehem mill—the only one of its kind in the country —turns out a top-quality impression-die steel forging at a cost that's hard to match.



This is Bethlehem's famed circular-products mill—the Slick Mill. Named for its designer, Edwin E. Slick, this unique machine produces impression-die circular forgings ranging from 10 in. to 46 in. OD; as-rolled weights ranging from 100 to 2,000 lb. It handles almost any grade of steel—carbon, alloy or stainless, as well as certain heat-resistant grades.

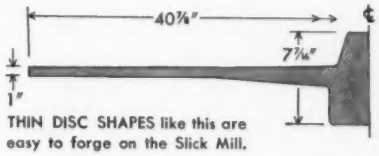


How It Works

Designed to operate in a horizontal plane, Bethlehem's Slick Mill is constructed with two *revolvable* spindles on which face plates are mounted. These face plates support the impression dies that form the steel billet into shape by a combination press and rolling action.

After the steel billet is heated and descaled, it is centered between the dies of the Slick Mill. Then a 1500-ton hydraulic ram actuates the spindle on the straight side of the mill, upset forging the billet. When this cycle is completed, a 2,000-hp motor actuates the spindle on the angle side of the mill and the rolling cycle begins. By continuing the upsetting action and rotation of the dies and work, the material flows into the recesses of the dies, resulting in the desired shape. *The entire rolling cycle takes about one minute.*

After rolling, excess material in the form of flash is sheared off; the hub, when necessary, is punched; and the forging is inspected.



THIN DISC SHAPES like this are easy to forge on the Slick Mill.

Cost-Saving Features

Quick operation: Only one minute is needed to convert a heated slug into a contoured forging, whether the product weighs 100 or 2,000 lb.

Quick die changes: Only 15 minutes are needed to change and set up dies. Even production runs as small as 25 or 50 pieces are economical.

Low die charges: Since contact time between die and work is very brief, and because there is no impacting, low-cost die blocks can be used. In many cases, die charges are ⅓ to ½ less than conventional impression dies.

Less steel needed: Utilizing the principle of forging design, the Slick Mill can produce lighter-weight sections without sacrificing strength.

Good physical characteristics: The process insures excellent grain flow, machinability and soundness.

Bethlehem's Slick Mill is readily adapted to jobbing or production quantities of forged circular products such as: gear blanks, fly wheels; crane track wheels; sheave wheels; brake drums; clutch discs; couplings; tire moulds; and turbine or compressor wheels. Products may be specified as-rolled or rough machined to specifications.

Your inquiry—whatever the quantity involved—will receive prompt attention. Call or write the Bethlehem sales office nearest you today.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

TUBING, Non-ferrous
American Brass Co., 25 Broadway, New York, N. Y.
Metal Forming Corp., Elkhart, Ind.
Mueller Brass Co., Port Huron 34, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.

TUBING, Steel
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Metal Forming Corp., Elkhart, Ind.
National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.
Timken Roller Bearing Co., Canton, Ohio.

TUBE & PIPE CUTTING-OFF MACHINES
Grieder Industries, Inc., Bowling Green, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.

ULTRASONIC MCH. TOOLS
Sheffield Corp., Box 893, Dayton 1, Ohio.

VALVE CONTROLS
Barnes, John S. Corp., Rockford, Ill.
Logansport Mch. Co., Inc., Logansport, Ind.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

VALVES, Air
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind
Mechanical Air Controls, Inc, Oak Park, Mich.
Ross Operating Valve Co., 110 E. Golden Gate Ave., Detroit 3, Mich.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Skinner Electric Valve Div., New Britain, Conn.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

VALVES, Hydraulic
Barnes, John S. Corp., Rockford, Ill.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio.
Elmes Eng. Div., American Steel Foundries, 1150 Tennesee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio.
Logansport Machine, Inc., 810 Center Ave., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

VERNIERS—See Calipers, Vernier; Gages, Vernier

VISES, Machine
Bridgeport Mches, Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio.
L-W Chuck Co., Toledo 4, Ohio
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Modern Mch. Tool Co., 2005 Losey Ave., Jackson, Mich.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

WELDING EQUIPMENT, Arc
Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
Lincoln Electric Co., 22801 St. Clair Ave., Cleveland, Ohio.
Linde Co., 30 E. 42nd St., New York 17, N. Y.

WELDING EQUIPMENT, Gas
Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
Linde Co., 30 E. 42nd St., New York 17, N. Y.

WELDING EQUIPMENT, Resistance
Eisler Engrg. Co. Inc., 750 South 13th St., Newark, N. J.

WELDING POSITIONERS
Eisler Engrg. Co., Inc., 750 South 13th St. Newark, N. J.

WELDMENTS
Bliss, E. W. Co, Canton, Ohio.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

WIRE
Allegheny Ludlum Steel Corp., Pittsburgh, Pa (Stainless)
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading Penna.
U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Penna.
Vanadium-Alloys Steel Co., Latrobe, Penna.

WIRE FORMING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J

WOODWORKING MACHINES
Greaves Mch. Tool Div., 2011 Eastern Ave. Cincinnati 2, Ohio.
Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.

WRENCHES, Allen, End, Socket, Adjustable, etc.
Allen Mfg. Co., Bloomfield, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

A Grieder Tube Cut-Off Machine will produce 4500 to 6500 cut-offs per hour

Grieder Tube Cut-Off Machines are 3 to 8 times faster than others, and speed is only one of the cost saving advantages they provide. For example:

- $ Cut tubing of any shape to any length—steel, copper, brass, aluminum and alloys. Continuous automatic operation.
- $ Lengths can be held to plus or minus .002" on light wall tubing and to .003" on heavier.
- $ Precision clamping dies prevent tube distortion and produce a quality cut. Tube does not rotate.
- $ Thousands of cuts without grinding. Blades can be sharpened on standard tool room equipment and used for as many as a million cuts.

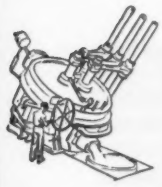
Write for literature, stating tube sizes and production requirements.

Grieder
TUBE CUT-OFF MACHINES

GRIEDER INDUSTRIES, INC.
P. O. Box 169 • Bowling Green, Ohio

Please send bulletin describing Grieder Tube Cut-Off Machines.

NAME_____
COMPANY_____
CITY_____ ZONE____
STATE_____



Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

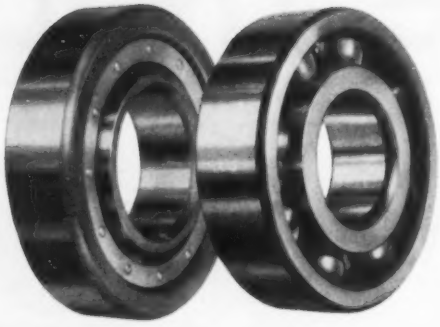
now...Lehigh H leads the field in machinability

As the result of its special annealed structure, developed and tested over a period of several years, Bethlehem's Lehigh H tool steel (AISI Type D-2) now leads the field in machinability among the high-carbon, high-chrome tool steels sold today. In impartial studies, the machinability of Lehigh H has been proved outstanding as a most economical grade for a wide range of difficult applications.

In addition to its better machinability, Lehigh H now has improved wear-resistance, because its vanadium content has been increased to 1 pct. Other important advantages of Lehigh H: improved carbide distribution and increased center density, based on U. S. Patent No. 2,809,109, issued to Bethlehem. Its uniform structure makes possible a better response to heat-treatment, and results in maximum service life for tools and dies, even in the most severe service.

Lehigh H is the D-2 type of air-hardening high-carbon, high-chromium tool steel, which is well known for minimum dimensional change in heat-treatment. For tops in machinability, and for all-around dependability and economy, be sure to order the new improved Lehigh H from your Bethlehem tool steel distributor.

Quality Bearings When quality counts



Precision chrome steel bearings from Japan.

Precision work alone is not enough. Continuous research, high technical skill and fine steel are needed to give bearings the durability and strength that makes a precise and profitable performance possible.

JBEC represents Japan's four largest bearing manufacturers and as such are the sole exporters of various types of top quality bearings to all fields of transportation and industry.

For reliable accuracy, minimum of maintenance, JBEC bearings are the bearings for long service.

NSK NIPPON SEIKO K. K.
(now in technical tie-up with the Hoover Ball Bearing Co.)

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NACHI FUJIKOSHI STEEL INDUSTRY CO., LTD.

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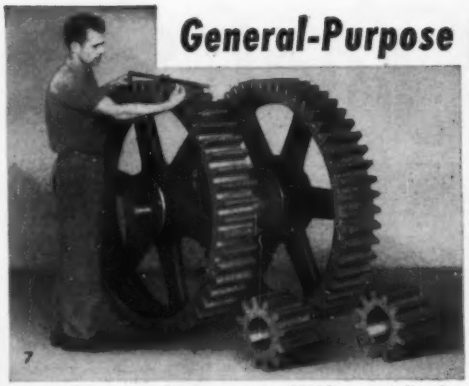
Toranomon Bldg., Minato-ku, Tokyo
Cable Address: "BEARYUSITSU" TOKYO

For more data circle Item 701 on Inquiry Card

General-Purpose GEARS



Gears for general purposes or highly specialized applications are all in the day's work at Stahl. Representative of the painstaking precision embodied in ALL Stahl gears are these steel spurs—54" O.D., 9" F., 6¼" B., 52 T., 1 D.P., and steel spur pinions—14" O.D., 9" F., 6" B., 12 T., 1 D.P. Teeth are flame-hardened. Be sure of unfailing accuracy and prompt delivery—get Stahl's estimate.

SPURS TO 72" PD. 1 DP
BEVELS TO 54" PD. 1 DP
SPIRAL, HELICAL and WORM GEARS TO 48" PD. 2 DP
CONTINUOUS-TOOTH HERRINGBONE TO 60" PD. 2 DP
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RACKS TO 20 FT. LONG. 3 DP
SILENT GEARS, RAWHIDE, BAKELITE, FIBROIL
HEAT-TREATED, CASE OR FLAME HARDENED GEARS—OF CARBON OR ALLOY STEEL

Stahl
GEAR & MACHINE COMPANY
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CLEVELAND 14, OHIO

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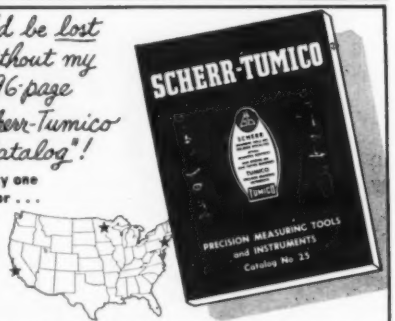

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M-D facing Head feeds automatically. Lathe tool bit travels radially from center outward or reverse. 10 sizes, 6" to 46" dia. Write for bulletin, prices.

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PRECISION GEARS UP TO 200 DIAMETRAL PITCH
All Gears certified for Accuracy Quality and Fine Workmanship
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Made to Your Specifications

You and we can form a team—you to draw up the specifications; we to make the gears—that will be profitable to both of us. Gears of all types, all sizes, all materials. Design-engineering service available.

Custom Gears Exclusively

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FOR WORMS AND WORM GEARS

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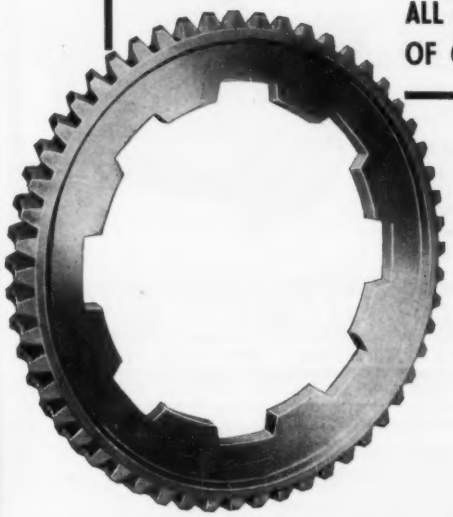
ALL TYPES OF GEARS



If you need worms and worm gears, come to BILGRAM. With over 70 years' experience specially designed equipment and a fully modern plant, we can supply you with gears that meet your exact specifications for accuracy, performance and quality.

We are equipped to fill *all* your gear needs: Bevel Gears with straight or spiral cut teeth . . . Ellipticals . . . Herringbones . . . Helicals . . . Racks . . . Spurs . . . Hypoids . . . as well as Worms. Get BILGRAM estimate on your next gear needs.

FOR ALL TYPES OF GEARS CALL

BILGRAM

GEAR & MACHINE WORKS

Manufacturers of Bevel Gear Generators and Chamfering Machines

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PHILADELPHIA 23, PA.

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The NEW Concept in AUTO-COLLIMATORS

- For testing angular deviations within tolerances of 1/10 second of arc.
- Short and compact design of 13" overall length.
- Measurements in 2 planes obtained by merely rotating eyepiece against positive stops.
- Range of focus 0-50 feet.

Request circular 85-200

OPTO-METRIC TOOLS, INC.

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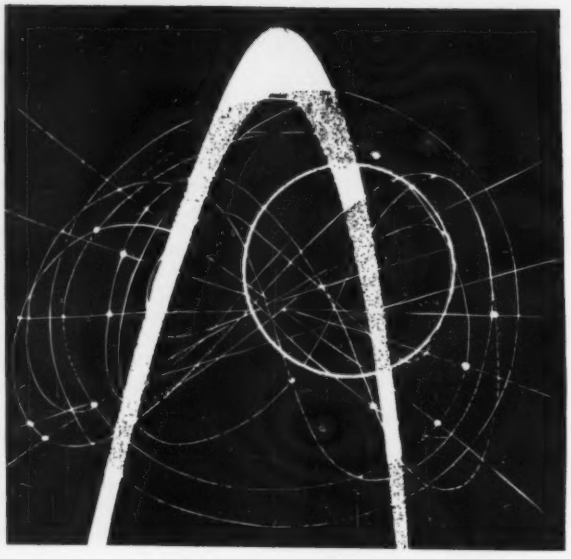
For more data circle Item 709 on Inquiry Card



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Total area of exhibition grounds: 520,000 sq. metres
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TOOL & DIE MAKERS KIT

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Kit contains 80 wheels and points in the most popular sizes and shapes, equally assorted in four grit textures, coarse (C), medium (M), fine (F), extra fine (XF)... plus four mandrels for ⅛" chuck... packaged in plastic box, compartmented for fast selection. $7.50 complete.

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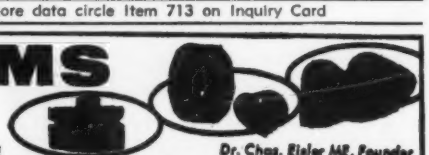
ALL TYPES MADE TO YOUR SPECS!



Cam Calculating Service

Dr. Chas. Eisler ME, Founder
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LITTLE GIANT COOLANT UNITS

Little Giant offers the ideal coolant unit for almost any machine tool operation . . . the reason is the Little Giant recirculating pump that operates when it is completely submerged in the coolant, either water soluble or oil base. Pump is totally enclosed within coolant tank, safe from damaging elements . . . recirculates coolant onto cutting tool, minimizing waste. Units manufactured in 5 gallon and 10 gallon tank capacity models. Like all Little Giant pumps, recirculating pump in coolant unit offers years of economical, trouble-free operation.

DESIGNED ESPECIALLY FOR MACHINE TOOL OPERATION

Little Giant Pump Company builds pumps for a variety of uses. Write for your catalog today.

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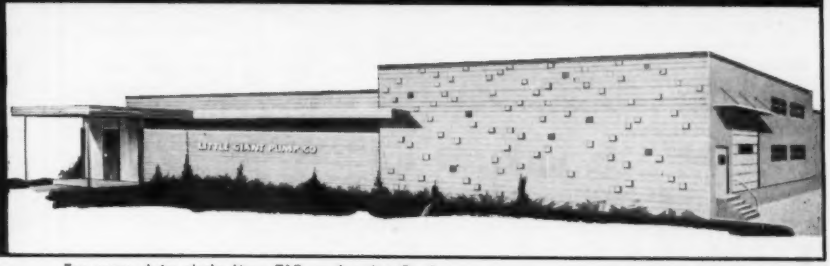
New Home of Little Giant Pump Co.—Triple Production Capacity to Meet Increasing Demand



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DYKEM STEEL BLUE

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303R North 11th St. • St. Louis 6, Mo.

CUT SCRAPER TIME
END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

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"A MANUAL OF PROCESS for THE COLD BENDING OF METALS and ABRASIVE CUT-MACHINING OF METALS" gives practical advice on all phases of cold bending and abrasive cutting. Simply written by shop men for shop men. Price $3.00.

Wallace Supplies Mfg. Co.
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FASTER PRODUCTION
with Lower Operating Costs!

NORTHERN "Proven Power" HYDRAULIC PRESSES

- Performance Proved in Many Plants
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- Close, Accurate Ram Control
- Smooth, Positive Power in Both Directions
- Manual or Solenoid Operation

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THE MARK OF DEPENDABILITY

The listing below is only a VERY SMALL AMOUNT of the total number of machine tools that we have in stock for immediate shipment. Our prices are realistic with today's market and our quality of rebuilding is the same high standard—THE LEADER IN THE FIELD OF REBUILT MACHINE TOOLS.

AUTOMATICS

9/16" Cleveland Model A, m.d., 1943
1-1/16" Cleveland Model B, m.d.
4 spindle 1-⅝" Cleveland, Model M, m.d.
4 spindle 2" Model K Cleveland, m.d.
2⅛" Cleveland, m.d., Model A
No. 4D Foter & Johnston, m.d., late
No. 5DELX Potter & Johnston, m.d., late
No. 4D Potter & Johnston, m.d.
5-⅝" Cleveland Model A Single Spindle, m.d., late

BOLT THREADERS

Victor Nut Facing Machine, m.d., cap. ⅝" to 2" nuts
1½" Landis 2 spindle, m.d.,
1½" Landis Bolt Threading Machine, double head stay bolt, m.d.

BOREMATICS

No. 44 Heald Facing Type Borematic, m.d.
No. 47A Heald Single End., m.d.
Model DB-102 Excello Double End Boring Machine, m.d.

HORIZONTAL BORING MILLS

No. 25T Giddings & Lewis, m.d.
No. 32 Lucas Table Type, m.d.
No. 1 Cleveland Horizontal Boring, Drilling & Milling, m.d.
3½" bar Cincinnati Gilbert Horizontal, Boring, Drilling & Milling, floortype
4½" bar, Model 72, Niles-Bement-Pond, m.d.
5½" bar Niles-Bement-Pond, m.d.
6" bar Sellers Floor Type, m.d.
Barrett Double End, 5" and 7" spindle, m.d.

VERTICAL BORING MILLS

16" Bullard Mult-au-matic, m.d.
24" Bullard Spiral Drive, m.d., 1944
36" Bullard, m.d., late 1944, Spiral Drive
36" Bullard Spiral Drive, m.d.
42" King, m.d.
42" Bullard Spiral Drive, vee belt m.d., 1944
42" Bullard New Era, m.d.
44" Putnam, m.d., p.r.t.
53" Niles Heavy Pattern, m.d., p.r.t.
60" Bullard, m.d.

BROACHING MACHINES

12x72" Thompson Automatic Flat Broach, m.d.
10 ton, 84" stroke LaPointe Single Ram Vertical Surface Broach, m.d., late
Type SBD-42-6 American Vertical Hy. Dup. Broach
Type SBD-48-15 American Vertical Dup. Ram Surface Hydraulic Broach

RADIAL DRILLS

4'—11" col. Morris Mor-Speed, m.d.
4'—13" col. American Hole Wizard, m.d.
4'—13" col. Foadick, 1944
4'—15" col. Cincinnati-Bickford, m.d.
6'—17" col. American Triple Purpose, m.d.
7'—16" col. American Triple Purpose, m.d.
8'—17" col. Dreses, gear box m.d.
Baush Radial Drilling & Tapping Machine, m.d.

BALL BEARING DRILLS

No. 4 Fosdick, 8" overhang, m.d., H.S.
No. 1B Edlund, m.d., new
No. 2 Avey, m.d.
No. 2LMS Leland & Gifford, single spindle H.S., m.d.
No. 2LMS Leland & Gifford, H.S., m.d.
No. ½ Avey MA8, m.d.
No. 4BM Fosdick, single spindle H.S., m.d.
No. 4MS Leland & Gifford H.S., 4 speed A.C. m.d. to spindle
1 spindle No. 2MA6 Avey H.S. Type B, m.d., 7½" overhang, 1943
2 spindle Atlas Bench Type, 1942
2 spindle Allen, belted m.d., 8" overhang
2 spindle No. 2 Avey H.S., belted m.d.
2 spindle No. 2BMA, 1 Avey Production Type, m.d.
2 spindle No. 3 MA6 Avey H.S., m.d.
2 spindle No. 2 Leland & Gifford H.S., 8" overhang m.d.
2 spindle Leland-Gifford H.S. Hydraulic Type, m.d.
2 spindle No. 3 MA6 Avey H.S., m.d.
2 spindle No. 2 LMS Leland & Gifford, Hydraulic step by step H.S., m.d.
3 spindle No. 3 Morse Taper, Foote-Burt "Sipp' H.S., m.d.
3 spindle No. 2B-8" Edlund, H.S., m.d.
3 spindle No. 2MA6 Avey, H.S., m.d.
3 spindle Leland-Gifford, 2'1LMS—H.S., m.d., late
3 spindle Leland-Gifford H.S., m.d.
4 spindle Leland-Gifford, m.d., on each spindle
4 spindle No. 15 Buffalo Bench Type
4 spindle Allen H.S., belt drive
4 spindle No. ½ MA8 Avey, m.d., H.S.
4 spindle Demco H.S., individual m.d.
4 spindle No. 2MS Edlund, m.d.
5 spindle Allen H.S., belt drive
6 spindle Allen H.S., 7" overhang
6 spindle Leland-Gifford, m.d., on each spindle, No. 2 taper
6 spindle No. 1 Avey High Speed, m.d.
6 spindle No. ½ Avey MA8 Avey, H.S., m.d.

UPRIGHT DRILLS

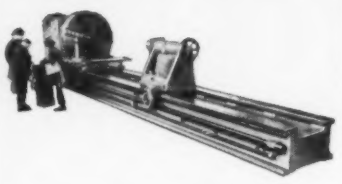
Model H3 Barnes Hydram, m.d.
Model H4 Barnes Hydram, m.d.
20" Barnes, m.d., 1940
20" Barnes All Geared Self-Oiling Drill & Tapper, m.d.
20" Cincinnati-Bickford Super-Service Prod. Drill, m.d.
21" Cincinnati-Bickford, single spindle, m.d.
No. 2AL Natco Holesteel Vertical, m.d.
No. 2 Colburn Mfg. Type, m.d.
No. 201-¼ Barnes Single Sp. Upright Drill & Tapper, m.d.
No. 25 Foote-Burt, m.d., H.D.
No. 150 Baker H.D. Single Spindle, vee belt drive, m.d.

GEAR GRINDING MACHINES

6x20" Fitchburg Hydraulic Spline & Gear, m.d.
GG19 Gear Grinding, m.d., latest
GG31 Gear Grinding, internal geared & spline grinder, m.d.
18" National Broach Red Ring Gear Lapper, m.d., late
18"National Broach Red Ring Gear Lapper, m.d., late
10" Pratt & Whitney Model M 1639 Single Wheel, m.d.
No. 12 Fellows Horizontal Gear Lapper, m.d.

The above is only a partial listing
WRITE FOR COMPLETE STOCK LISTING

THE EASTERN MACHINERY COMPANY
1006 Tennessee Avenue, Cincinnati 29, Ohio • MElrose 1-1241 • Cable Address EMCO



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It's big—**60" swing x 33 foot bed.** ¾" hardened steel wearing plates installed in bed—also formica wearing plates under carriage and aluminum bronge under cross slide and tail stock. Tolerances same as new—performance same as new—price small fraction of new.

Automatic Cut-Off: 1¼" 4 spindle cone, vert.
Auto. Chucker: 6½" No. 665 New Britain, 1943
Balancer: Tinius Olsen prop. shaft, 1948
Borer: No. 47A Heald, sgl. end
Borer: DB1212A Ex-Cell-O, 1949
Boring Mill: 4" bar Universal table Timken
Broach: 10 ton 54" American vert. duplex
Centering: 6" x 72" No. 56 Sundstrand
Compressor: 650 CFM Sullivan duplex, 125 HP
Drill, Deep Hole: 420 W. F. & John Barnes, 1942
Drill, Multiple: No. 48L Natco, 36 spdl.
Drill, Upright: 21" Cin. Bick. 1L superservice late
Drill, Upright: 22" Barnes, late
Drill, Radial: 4'11" Carlton, 1941
Drill, Hydr.: No. 25 Ex-Cell-O, late
Gear Hobber: No. 3 Barber Colman, pres., late
Gear Shaver: 8" Red Ring, 1940
Grinder, C'less: No. 12 Landis, 1948
Grinder, C'less: No. 2 Cincinnati, Almatic
Grinder, Disc: 22" No. 221 Hanchett opposed
Grinder, Int.: No. 74 Heald, 1941
Grinder, Surf.: 12" x 36" Mattison, 1942
Grinder, T&C: No. 2 Cincinnati, 1944
Lathe, Auto.: 8" x 15" Sundstrand
Lathe, Auto.: No. 8 Gisholt, 1950
Lathe: 16" x 54" American Pacemaker, 1941
Lathe, Engine: 24" x 120" Monarch Model CM, 1943
Lathe: 25" x 72" Axelson, 1944
Lathe, turret: 9½" Nole No. 41 Gisholt
Mills, Boring: 60" Gisholt, vert. CCG
Mills, Prd.: No. 33 Sundstrand Fluid-Screw, 1942
Mills, Prd.: No. 4-48 Cincinnati, late
Mill: No. 3H K&T, plain, 1943
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Mill: No. 36 VanNorman, ram, 1942
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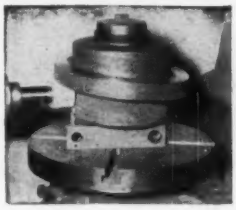

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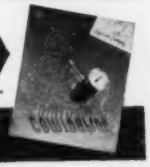

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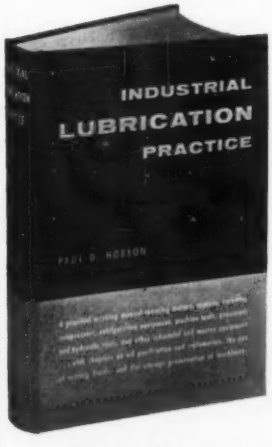

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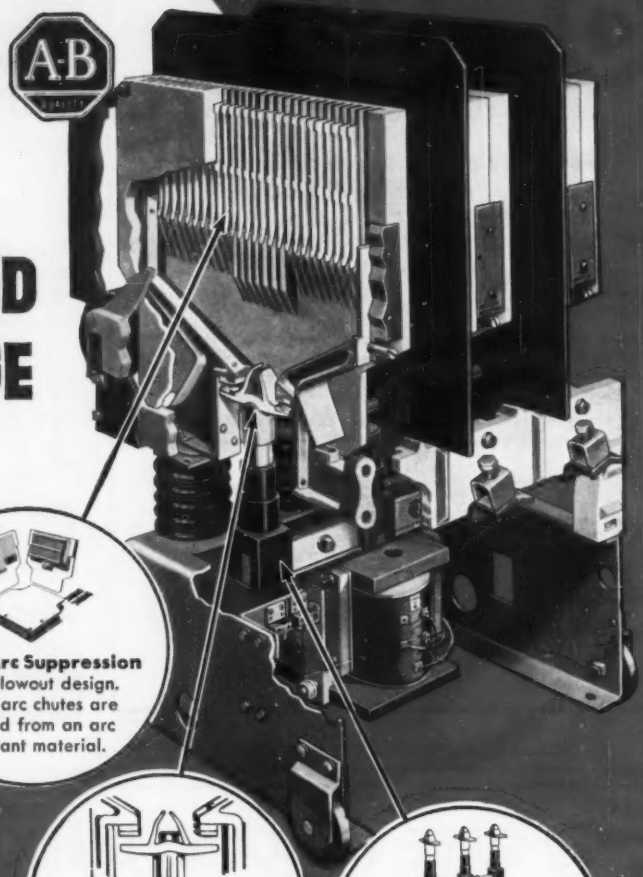

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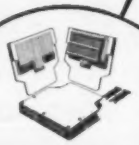

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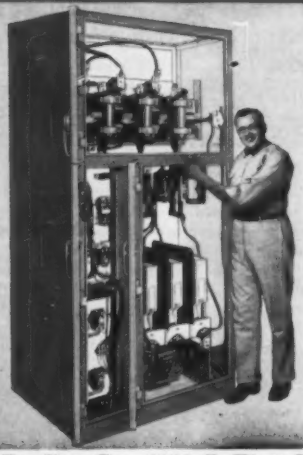

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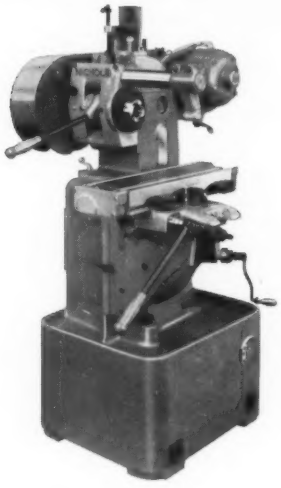

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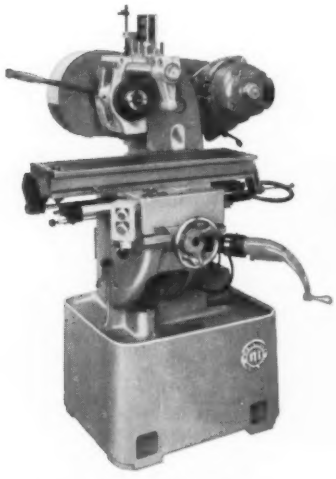

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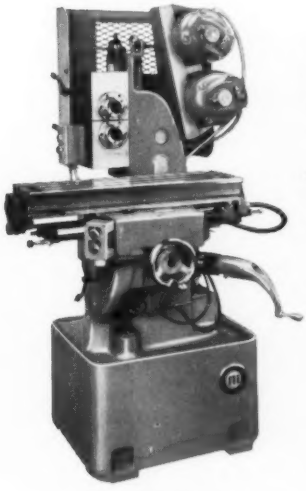

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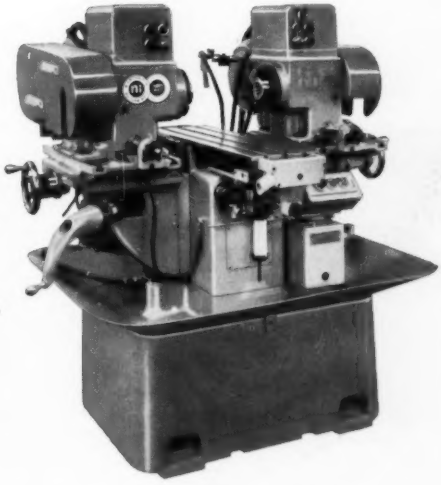

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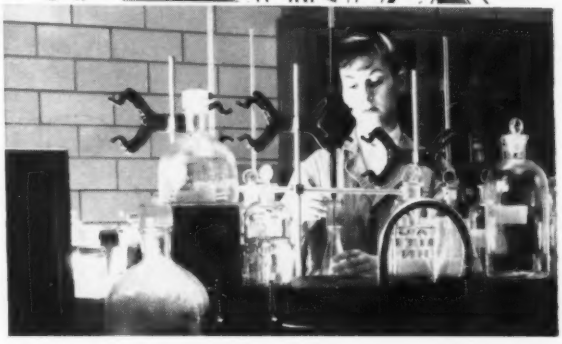

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